2006

# Of fish and people: Managerial ecology in Newfoundland and Labrador cod fisheries

Dean Louis Yelwa Bavington
*Wilfrid Laurier University*

# Of Fish and People: Managerial Ecology in Newfoundland and Labrador Cod Fisheries

by

Dean Louis Yelwa Bavington

B.Sc.(H), Acadia University, 1995
M.E.S., York University, 1997

DISSERTATION

Submitted to the Department of Geography and Environmental Studies

in partial fulfillment of the requirements for

Doctorate of Philosophy in Geography and Environmental Studies

Wilfrid Laurier University

2005

*Your file Votre référence*
*ISBN: 0-494-09915-1*
*Our file Notre référence*
*ISBN: 0-494-09915-1*

## Abstract

This dissertation aims to understand the history of, and possible alternatives to, managerial responses to socio-ecological issues by examining one of the largest natural resource management failures of the twentieth century—the collapse of the Northern cod fisheries off Newfoundland and Labrador, Canada. In 1992, the Northern cod fishery off Newfoundland and Labrador (the world's largest ground fishery) was shut down. The Northern cod had been reduced to 1% of their historic spawning biomass and cod fishing as a way of life had come to an end after a 500 year history.

The dissertation develops and applies a critical theory of managerial ecology to explore the history and consequences of managerial ideas and interventions into the cod fisheries. It argues that managerial ecology is deeply implicated not only in leading to the collapse of the cod fisheries and the failure of cod stocks to recover, but also in creating new ecological and social problems that cannot be solved by new and improved managerial designs.

The dissertation describes the ascendance of managerial ecology within Newfoundland and Labrador cod fisheries beginning with the history of the birth of the fisheries management idea and its development up to the 1992 moratorium on cod fishing. Developments post-1992 are then presented, emphasizing the tendency of politicians, bureaucrats and academic researchers to offer innovative managerial strategies for the cod fishery rather than calling into question managerial relationships themselves and proposing fundamental alternatives. It illustrates how under post-92 reforms, cod have become managed as elements in complex ecosystems as opposed to single species populations; how traditional fishers who want to continue fishing are

required to become self-managing professional fish harvesters; and how industrialists and government bureaucrats promote the idea that the wild cod fishery should be replaced by industrial fish farming.

The dissertation concludes with a reflection on the development of managerial ecology in the face of natural resource collapse. Suggestions are made for future research directions in environmental studies that move beyond managerial ecology by focussing on lessons emerging from complex ecosystem science that challenge the efficacy of management as well as normative-political arguments that question its legitimacy.

## Acknowledgments

This dissertation represents a collective effort with encouragement, help and support from many different people located all across the world. Without this support I would never have been able to undertake this scholarship. I would first of all like to thank my advisor Scott Slocombe at Wilfrid Laurier University. Scott not only encouraged me to work with him but allowed me the space to explore critically many themes related to managerial ecology in addition to challenging me to apply my theoretical insights to the Newfoundland cod fisheries case. In addition to being a helpful advisor Scott offered multiple opportunities that took my research in interesting new directions, most notably in the area of cod aquaculture research.

I would also like to recognize the support, encouragement and insight provided by my comprehensive exam and dissertation committee members: Bob Gibson, George Francis, Ken Hewitt, James Kay and Kevin Hanna. In addition to helpful advice, committee members offered publishing opportunities, engaging discussions, and most importantly a mentoring community. I particularly cherish the time I was able to spend learning from James Kay before his passing. James Kay offered friendship and insights into the world of complex systems that I will continue to draw on for the rest of my academic and personal life. In particular, I warmly recall the discussions and mentorship offered by James Kay and George Francis in my ecosystem-based fisheries management work and the facilitation they provided into the world of post-normal science in the PNS discussion group that was invaluable to my intellectual development.

I also wish to thank Carolyn Merchant at the University of California—Berkeley for her friendship and mentorship. In 2000 I spent an extremely enjoyable and formative year as a Fulbright scholar working with Carolyn at UCB. Her enthusiasm for my project and her openness to my questioning and development of her partnership environmental ethic helped to sustain my interest in critically engaging with managerial ecology and offered hope for alternatives. Carolyn's encouragement, seminal knowledge and influence in environmental studies in addition to the many seminars and courses I participated in while at Berkeley were pivotal to my intellectual development and ability to critically engage with managerial ecology.

While attending Berkeley I also had the honour of meeting Ivan Illich and participating in a series of seminars with his friends and colleagues in Oakland. Illich's friend Sajay Samuel became a close friend and mentor during the process and in the years since he has contributed to my understanding of management, especially its deep historical roots and contemporary influence. I look forward to future collaboration in the area of critical management studies with Sajay and thank him for his friendship and support during my doctoral program. In addition, I would like to thank Max Oelschlaeger who has continually supported me as an intellectual mentor and friend since our first meeting at Acadia University in 1995. Without Max I would not have continued on in academia or pursued the research I have on the cod fisheries.

I also wish to thank Barbara Neis and Rosemary Ommer at Memorial University and the University of Victoria for giving me the opportunity to participate in the *Coasts Under Stress (CUS)* research project and offering their friendship and mentorship. Barbara's generosity in including me as the primary co-author of a paper she originally drafted and encouraging me to undertake field work in Labrador greatly influenced my understanding of fisheries issues and fully integrated me as a CUS team member at Memorial University.

In addition to these academic supporters I want to single out my friends and family who have supported me in innumerable ways throughout this degree. This has been especially true of my best friend and love of my life, Jodi Oliver, who has not only listened patiently to my ideas on management and provided crucial editorial suggestions but selflessly offered laughter and tenderness just when I needed them most. My parents Bill and Grace Bavington and sister Beth Ann have always supported my academic pursuits and have remained interested and involved in the ideas I have developed over the years. Friends have provided crucial support for the ideas that I developed during my degree to the point where it is hard to determine where my ideas start and theirs begin. Some of these include: Reade Davis, Heath Priston, Emily Head, Nick Garside, Matt Szabo, Mark Hudson, Beth Dempster, Dan McCarthy, Fred Winsor, Greg Zuschlag, Belinda Lyons and Darcy Butler.

I would also like to recognize for their financial support *AquaNet*, the Social Science and Humanities Research Council of Canada, *Coasts Under Stress*, the US-Canada Fulbright Program, Wilfrid Laurier University and the Ontario Graduate Scholarship program. I am aware of how lucky I have been in obtaining funding during such lean times in the academy. Without this monetary support I would not have been able to undertake this research.

# Table of Contents

# List of Figures

## List of Tables

# CHAPTER 1

## Introduction

> The sea there is swarming with fish which can be taken not only with the net but in baskets let down with a stone, so that it sinks in the water (Raimondo di Soncino, *quoted* in Kurlansky 1998:48).

On the surface, the story of the northern cod fishery appears to be a classic case of uncontrolled human exploitation, ignorance, and lack of management pushing an unfathomably abundant species toward scarcity and extinction. Like the now-extinct flocks of passenger pigeons, so numerous they reportedly blocked out the noonday sun, or the seemingly infinite numbers of plains buffalo that once obstructed the paths of onlookers for hours at a time, northern cod (*Gadus morhua*) abundance and decline has become legendary.

The first European explorers to Newfoundland at the end of the fifteenth century reported cod so thick they slowed the movement of ships and could be scooped from the sea in baskets (Kurlansky 1998). Cod abundance in the waters off Newfoundland and Labrador supported the largest ground fishery in the world leading to an international "cod rush" that attracted over twenty fishing nations (Hutchings and Myers 1995). From 1500-1992 approximately 100 million tons of cod were killed (Rose 2003). Then, on July 2, 1992 the cod fishery that had been pursued for over 500 years came to a sudden end. Canada's Fisheries Minister, John Crosbie, a Newfoundland citizen, made the staggering announcement that the northern cod fishery had to be immediately shut down.

Crosbie placed a moratorium on all cod fishing off the northeast coast of Newfoundland and Labrador thereby ushering in the largest layoff in Canadian history (Millich 1999). Over 30,000 people were put out of work and the cod were declared a *commercially* extinct species (Rose 2003). By 2003, after more than a decade of rotating fishing moratoria, cod was recommended for placement on Canada's endangered species list raising the spectre of *biological* extinction (COSEWIC 2003, SARA 2004ab). Cod breeders—the so-called spawning stock biomass—were estimated to be at a level that was less than 1% of what they had been historically (Hutchings and Myers 1995, Hutchings 2004).

So what happened? Did the cod simply suffer the same fate as the plains buffalo and the passenger pigeon? Upon closer inspection, similarities between the collapse of cod and other species break down. Unlike the demise of passenger pigeons and the plains buffalo the northern cod collapse was *scientifically managed into existence*. Rather than a case of ignorance, neglect, or lack of management, prior to the moratorium the northern cod fishery was presided over by one of the world's most comprehensive renewable resource management systems (Newell and Ommer 1999). Almost overnight, the northern cod fishery went from an example of managerial best practice to a textbook case of fisheries management failure (Finlayson and McCay 1998). The story of the northern cod fishery is an astonishing example of management creating the very thing it was designed to prevent (Steele *et al.* 1992).

Most retrospective investigations into the cod collapse have highlighted numerous cases of mismanagement, producing a vast array of proposals for new and improved managerial interventions. Academic, bureaucratic, economic, and everyday discussions around what to do about the cod collapse have largely become arguments around competing managerial designs with disagreements over *what* should be managed, *who* should do the managing, and *how* fisheries management should be reinvented.

While these proposals for the reinvention of cod fisheries management often suggest contradictory explanations for the underlying causes of the fishery collapse, and offer divergent proposals for intervention, they all agree that new and improved management is the solution. The proposals differ only on the specifics of their managerial designs. None questions the usefulness of the *idea* of management itself. The inherent worth of management is taken as a given and the implications of framing the cod collapse as a management failure are left largely unexplored.

Could it be, however, that the very *idea* of cod fisheries management is somehow flawed? In the rush to propose managerial solutions to the cod collapse could an important opportunity to thoroughly explore management itself have been overlooked? Is it possible that cod fisheries management is part of a broad managerial ecology that raises management to an ideal, thereby confining responses to the cod fishery collapse? Despite broad based agreement and volumes of academic and governmental studies on the failure of cod fisheries management, the underlying *idea* of management itself, and the inherent value of managerial ecology more broadly, have largely escaped critical engagement. This dissertation is motivated by a desire to fill this gap in the literature, to critically interrogate the idea of management as it has been, and is currently being, applied to cod and cod fisheries in Newfoundland and Labrador and to begin to explore the possibilities for thinking before and beyond managerial ecology.

The remainder of this chapter lays the groundwork to begin a critical exploration of managerial ecology in Newfoundland and Labrador cod fisheries. First, I provide definitions of managerial ecology and management and discuss how managerial thought dominates responses to a wide range of environmental, social, economic, political and individual concerns. I then introduce the Newfoundland and Labrador case study giving an overview of the major managerial responses to the cod collapse. Finally, I outline my dissertation questions and provide a brief synopsis of the chapters that follow.

### 1.1 Managerial Ecology—The Answer is Better Management, Now What Was the Question?

> Management is a tertiary skill—a method, not a value. And yet we apply it to every domain as if it were the ideal of our civilization (Saul 1995:200).

Carolyn Merchant (1980) describes managerial ecology as a modern utilitarian approach to nature with philosophical roots in the Enlightenment and the revolutionary economic, political and scientific order that began to emerge in 16th and 17th century Europe. As society became increasingly organized around the dictates of the market, and a scientific view of nature gradually replaced organicism, "a value system oriented to nature as a teacher whose ways must be followed and respected" gave way to a system of human values focused on "efficiency and production in the sustained use of nature for human benefit" (Merchant 1980:238). "Managerial ecology," Merchant explains, emerged out of the scientific and industrial revolutions to become the dominant way of framing society-nature interactions as modern people sought to "maximize energy production, economic yields and environmental quality through ecosystem modeling, manipulation, and prediction of outcomes" (1980:238).

By assuming that solutions ultimately lie within the hands of managers, that better organization is the key to improvement, and that problems can be solved merely by increasing effort or efficiency, managerial ecology has come to significantly constrain human relations with the natural world, obscuring alternative ways of framing and responding to environmental issues (Luke 1999a, Pollitt 1990, Sachs 1993, Torgerson

1999). While theories, practices, philosophies, and meanings of management have changed significantly over time, faith in management's applicability has only strengthened (Parker 2002). Indeed, management of all kinds has expanded rapidly in the 20th century to become ubiquitous, dominating the way social, economic, political and environmental issues are framed and addressed (Grey 1999, Torgerson 1999, Bavington 2002, Parker 2002). As Paehlke and Torgerson (1990:5) observe:

> If there is a problem, better management is often assumed to be the solution. This assumption has deeply influenced the rise of advanced industrial societies and now guides much of the response to environmental problems.

Max Oelschlaeger (1994) supports the observations of Paehlke and Torgerson (1990) tracing managerial responses to the global ecological crisis back to the Enlightenment period. It is not surprising that the Western "intelligencia would want to manage their way out of ecocrisis" Oelschlaeger (1994:47) explains, "because that is the Western *paradigm*. We have been trying to manage the planet for at least three hundred years."

Management thinking now defines much geographic and environmental scholarship and practice. Charting and measurement, tools central to the enterprise of modern, scientific geography, are vital to the exercise of managerial powers. This is the case not just for empires and states (*as per* Scott 1998), but also economic elites and corporations interested in conquering, instrumentalizing and commodifying space. Such ambitions are clearly reflected in the contemporary digitization and remote sensing of space, whether the aim is to manage fish, forests and fields, competitive commercial advantage, or the experience of modern warfare (Smith 2000a). Despite proclamations by environmental scholars of worldwide crises (Holling *et al.* 2000), pathologies (Holling and Meffe 1996) and even the end of management itself (Ludwig 2001), managerial interventions remain firmly mapped across the earth's face and stand unchallenged as the dominant legitimized response to a host of social, political, economic and ecological problems (Parker 2002).

### 1.2 What Does Management Mean?

Despite the grip that management holds over the contemporary imagination, clear definitions of the term and its implications remain largely unexplored. At first blush, management appears to be a word without history or geography, a received tool, a ubiquitous technical necessity, a rational given. Management has been described as a "plastic" archetypically pliable term, because its use conjures up numerous connotations without a specific denotation (Poerksen 1995). However, the etymology of management foils this interpretation. The term, in fact, encompasses three principal meanings: management-as-control, management-as-caretaking, and management-as-coping (Bavington 2002).

Management-as-control originates in Italy during the 16$^{th}$ century. Descending from the Latin root word for hand, *manus*, the Italian *maneggiare* suggests the exertion of dominion over nature through the breaking and training of horses (Williams 1980). Extended through to the present, the essence of management-as-control can be found in the faith that management can successfully manipulate nature, human beings and, increasingly the enterprise of management itself (Parker 2002:3). Management-as-control implies steering and directing along a charted course. Managers handle people, objects and processes indirectly through representations that enable executive action. As Petter Holm (1996:179) observes "management is a control strategy by which processes or people are handled indirectly through a system of representation." These representations simplify the world, turning it into a malleable space. Through a wide variety of scientific and technical methods, people and other living species are rendered legible as resources, subject to the handling of managers. Once objectified and quantified, the world becomes an actionable space open to rational control and instrumentalized action from a distance (Holm 1996, Law 2001).

During the early part of the 17th century, the meaning of management was influenced and confused by the entrance into the English language of the French word *ménager*, meaning to use carefully (OED 1989). With its Latin root *mansionem*, meaning a dwelling or household, the introduction of *ménager* shifted the meaning of management to a different location (the household in place of the horse corral), a different set of activities (housekeeping as opposed to horse training), and a different set of attitudes (caretaking and wise stewardship instead of command and control) (Bavington 2002). The caretaking sense of management introduced a domestic and morally positive association of management with housekeeping, stewardship and husbandry.

This warm, paternal meaning of management, conjuring illusions of happy households, well tended gardens, and wise pastoral custodians, introduced misunderstanding with its application throughout the 17th and 18th centuries (Williams 1980). The term "manager" thus came to encompass *both* the identity of trainer and director as well that of a careful housekeeper, husband, leader, custodian, and steward (OED 1989). While management-as-control referred to a hierarchical two-way relationship between the manager and the managed, management-as-caretaking placed the manager into the role of custodial middle man, entrusted to use objects previously mapped and staked by an owner or master creator in the heavens (Palmer 1992). Management-as-caretaking involves a hierarchical three-way relationship between owners, stewards and wards (Roach 2000). Stewards look after and carefully use private property ultimately owned and thereby presumably controlled by someone else who is positioned above the steward. Management-as-caretaking does not indicate a relationship of altruistic care for another person or an autonomous subject that is accorded intrinsic value, rather it implies looking after and tending to objects and possessions—forms of property with instrumental value. Management-as-caretaking, therefore, points not only up to control but down to a third meaning of management, one epitomized by the position of the ward or the managed (Bavington 2002).

The plight of wards or the managed is to cope with being controlled and carefully used. The third meaning of management (management-as-coping), therefore, implies the opposite of management-as-control and caretaking. Coping as a management strategy is a response to being controlled or carefully used. It refers to situations of unequal power where the one coping functions like "a subsystem, a creature that functions within an oppressive system" (Esteva *et al.* 2005:23). Management-as-coping implies that one is "just getting by", barely "managing" in a system or environment over which one has little say, ownership or control.

When control or caretaking breaks down, the position of the manager suddenly becomes that of the ward. In the context of managerial failures, managers can merely cope with disorder, uncertainty and conflict while trying desperately to restore an order that allows them to regain control and caretaking ability. As I will illustrate in the proceeding chapters, when this type of managerial coping appears in natural resource management the control and caretaking functions of management do not cease to exist but rather shift their targets—from the unmanageable to something perceived as more manageable. In this instance, management-as-coping becomes an instrumental, institutionalized response to a crisis brought on by a temporary loss of control or caretaking ability. As inequality and perceptions of interconnected, heterogenous, global systems, failure, risk, uncertainty, ignorance, conflict and complexity have increased management-as-control and caretaking have declined in significance leading to the expanded use of management-as-coping (Thompson and Trisoglio 1997).

In addition to the above managerial meaning of coping there are non-managerial meanings. Coping can also refer to an acceptance of limits, a way of living that does not seek to achieve control over or caretaking of nature. Precedents to this way of living with nature are evident in the pre-industrial, pre-modern period before the advent of managerial ecology when nature was understood to be a live organism. In the conclusion of the dissertation I explore how a form of non-managerial coping might serve as a contemporary alternative to managerial ecology if nature were truly understood as a complex ecological system, something that cannot and ought not be controlled and stewarded as alienable property.

Confusion between "coping" that results from the exercise of managerial control or caretaking versus non-managerial "coping" as a personalized response to a local problem without ties to systems of power makes defining management difficult and has facilitated confusion around its meaning. In this dissertation I explore the use of these three meanings of management in natural resource management in general and in the cod fisheries in particular. When I explore possible alternatives to managerial ecology in chapter nine I argue that a non-managerial interpretation of coping has the possibility to become a way to move beyond the hegemony of control and caretaking approaches to cod and people in Newfoundland and Labrador cod fisheries. My thesis is that when taken seriously and separated from control and caretaking, an emphasis on coping can undermine the constant striving for manageability and reveal alternative possibilities for interactions between cod and people.

From humble beginnings in horse handling and housekeeping, managerial thinking has expanded in scope to include economies, ecosystems, resources, environments, industries, trans-national corporations and human labour. Even emotions, values, beliefs, motivations and life in general are now viewed as being in need of, and amenable to, managerial interventions. In any or all of its three guises, management has been used to describe most every aspect of daily life, and in so doing it has entrenched the notion that everyone everywhere is a manager—and always has been (Grey 1999).

It is important to remember that in practice, management remains rhetorically pliable. It can simultaneously mean all of control and coping with the lack of control; careful use and coping with misuse; controlling private access while promoting participatory stewardship; not to mention coping when all the assumptions permitting a belief in control and caretaking have broken down. In this context, battles are waged over *types* of management as opposed to drawing attention to the effects of pervasive managerialism. As Parker (2002:11) observes, managerialism, of which managerial ecology is but one example, focuses on a narrow conceptualization of management as a generalized technology of control and caretaking applied "to everything—horses, humans and hospitals. This is management as the universal solution, not a personal assessment of a local problem." In what follows, I argue that managerial ecology—the particular version of managerialism constructed during the Enlightenment—is deeply implicated in the cod fisheries collapse and has limited our collective capacity to imagine alternative forms of organizing human relationships with cod in Newfoundland and Labrador. Within the multiplicity of conflicting meanings of management, possibilities to explore the philosophical, political and moral implications of managerial ecology are easily lost.

This dissertation argues that the expansion of management and its colonization of environmental discourse and practice should not be taken by geographers and environmental studies scholars as a sign of the end of history leaving us with little more than resignation, cynicism or acquiescence. Rather, this state of affairs points to the need for a critical understanding of the enterprise of management itself. It is important to ask how management has mobilized natural resource geographers and how it has been deployed to address environmental issues at particular times and in specific places. Only when a clear description of the multiple meanings of management, their interconnections, and how they have been expressed in particular geographic practices over time is achieved can a space be provided to begin to understand managerial ecology and its alternatives. It is important therefore to be able to distinguish among the three meanings of management keeping in mind that they are all interconnected. The coping meaning is particularly important especially because it holds ambiguous potential referring as it does to both the oppressed position of the managed that calls out to be transcended and an approach to the world that abandons managerial dreams of control and caretaking that lie at the centre of the meaning of managerial ecology. The history of the development of managerial ecology in the cod fisheries and the ambiguity of coping will be explored in the proceeding chapters of the dissertation.

### 1.3 Managerial Ecology in Newfoundland and Labrador: The Case of the Northern Cod Fishery

In a comprehensive review of the cod fisheries management literature published since the fishing moratorium was declared in 1992, Sean Cadigan (2001) groups the various management remedies for the fishery into two main schools of thought. One school of thought supports a neo-liberal management perspective that has significantly influenced government policy in the wake of the northern cod collapse. Another, less influential school of thought, comes from socialist and communitarian perspectives.

The neo-liberal school of thought frames the cod collapse as a classic case of Garret Hardin's (1968) "tragedy of the commons" thesis[1]. Neo-liberals advocate a thorough privatization of fisheries, favouring managerial tools that achieve "mutual coercion mutually agreed upon" through the self-organizing powers of the market's invisible hand. They argue that when Canada extended national jurisdiction over its 200 mile exclusive economic zone in 1977 it did not manage the new national property in the interests of cod (Blake 2000). Rather, the enclosed ocean space was managed as

---

[1] Garret Hardin's highly influential tragedy of the commons thesis was presented in an article first published in *Science* in 1968. In the article Hardin presents a tragic neo-Malthusian tale. A common pasture is destroyed when its users, modeled as a collection of individuals out to maximize their short term gain, overexploit the unpriced, uncommodified grass of the commons by grazing as many cattle on it as they can. Tragedy ensues when the carrying capacity of the common pasture is exceeded as each individual attempts to maximize their gain. Hardin's Tragedy of the Commons thesis assumes that individual self-maximizing behaviour is a natural, universal characteristic of human beings and suggests that privatization of commons either by turning it into state or individual property, is the only avenue to avert tragedy. Hardin's presentation of people as asocial, atomized, self-interested individuals and commons as tragedies waiting to happen has been criticized for naturalizing and reifying a very narrow view of human and biophysical nature and for mistaking a tragedy of open access for a tragedy of common property resource systems (Acheson and McCay, 1990 and Ross 1998). The tragedy also seems to imply the empirically dubious claim that if the commons is turned into property, overexploitation will automatically be averted (Fairlie *et al.* 1993).

monopolized State property to implement social policy objectives such as maximizing modern fisheries related employment and negotiating favourable terms of trade for Canadian exports (Harris 1998). Neo-liberals argue that creating and defending exclusive property rights for fish would remove this legacy of ecologically harmful and expensive government control over fisheries management (Crowley 1996). They propose that by transferring management tasks to self-managing private fishing quota owners with an interest in conserving their private property, fishing behaviour can be steered by market mechanisms tied to the relative abundance of fish as determined by fisheries scientists verses quota limits set by expensive and ineffective central planners in Ottawa (Crowley 1996).

On the other side of the cod fisheries management debate is the socialist-communitarian school of thought. It frames the cod collapse as a tragic case of state mismanagement driven by the interests of an industrial capitalist system that promoted inappropriate scientific and industrial models of both cod, fishers and the fishery. Proponents of this perspective argue for a reinvented fisheries management re-embedded in the interests of coastal communities through the encouragement of "new partnerships between fishers, fisheries scientists and fisheries managers" (Cadigan 2001:171). This approach to fisheries management, while less successfully implemented into government policy, has encouraged a wide variety of policy research in three broad areas. First, there is a growing literature advocating the integration of local ecological knowledge into fisheries science and management (Neis and Felt 2000). Second, scholars are exploring the ways in which normative control based on community-based stewardship-ethics and nested governance versus top-down state-mandated rational control can be encouraged

(Apostle *et al.* 1998, Newell and Ommer 1999). Third, some researchers argue for the allocation of fishery resources to place-based communities through the adjacency principle to address equity concerns (Coward *et al.* 2000). The socialist-communitarian position focuses on debunking the tragedy of the commons thesis, illustrating historical and contemporary examples of the collective management of common property—given the right norms and material conditions (Matthews 1993, Cadigan 1999ab, 2001).

Neither the neo-liberal nor the socialist-communitarian schools of thought fundamentally question the need for, or the usefulness of, management. Both agree that management is the solution, they simply argue over the correct managerial means. The neo-liberal perspective places fisheries management within a history beginning with Canada's enclosure of the ocean commons in 1977. It frames management as a triumphant story of science and technology's linear progression toward increasing human control, prediction and ultimate stewardship of enclosed sections of commodified nature. Accordingly, inefficient state-led fisheries management is to be replaced by finely tuned market mechanisms that steer the behaviour of an exclusive group of economically rational fish harvesters. The socialist-communitarian school of thought criticizes the inequities produced by state-guided scientific fisheries management and the market managerialism of the neo-liberals. However, in a bid to justify the value of fishing people in the wake of the cod collapse, socialist-communitarians have tended to naturalize management as a neutral tool that can be put to good use if control and caretaking are deployed by local fishing communities in partnership with social scientists and the state (Gray 2002, Holm 2003).

Both neo-liberal and socialist-communitarian schools of thought rely on narrow assumptions of human nature and the benefits of enclosing fish stocks as property to achieve control over, and careful use of, nature (Mansfield 2004). Both represent fishing people as economically rational actors who naturally seek to maximize short term profits from their fishing activities in the absence of managerial constraints (Mansfield 2001). While neo-liberals propose competitive market mechanisms to achieve managerial constraint over individual economic actors, socialist-communitarians argue that a variety of cultural practices and institutional designs can achieve managerial constraint in ways that make it economically rational for individuals to co-operate and work together (Mansfield 1999). In both schools of thought managerial constraints are to be achieved through the enclosure of "the oceans within carefully delimited regimes of property, be those regimes of collective, state, or private control" (Mansfield 2004:313).

Existing cod fisheries management regimes in Newfoundland and Labrador have favoured the neo-liberal approach that reflects the Federal and provincial governments' current passion for market-based solutions. Parts of the socialist-communitarian argument for cultural practices and institutional designs that encourage co-operative management of common *property* have been applied as long as they have been made congruent with government downsizing and downloading initiatives (Murray *et al.* 2005). However, both of these approaches have helped to enlarge managerial ecology without fundamentally questioning the enterprise of management itself with its focus on the control and caretaking of nature conceived as various forms of property.

### 1.4 Questioning Managerial Ecology in Newfoundland and Labrador Cod Fisheries

In order to gain critical distance from the ideological debates in cod fisheries management and to explore the possibilities for thinking before and beyond managerial ecology, this dissertation poses and answers three main questions. First, it asks: "When, how and why did management come to be applied to cod fishing and what was the original form of the management regime in Newfoundland and Labrador?" Answering this question helps to situate historically and geographically the emergence of cod fisheries management in order to understand the complex context from which managerial ecology in the cod fishery sprung. The second question asks: "What have been the major managerial responses to the collapse of the cod fishery?" Detailed answers to this question illustrate the ongoing resilience of managerial ecology in the face of failure and document the specific ways cod fisheries management in Newfoundland and Labrador has been restructured in response to the demise of wild cod. The third question asks: "Are there alternatives to managerial ecology in Newfoundland and Labrador cod fisheries?" Answers to this final question serve three main purposes. First, they provide an opportunity to reflect on the case study and clarify exactly how managerial ecology has expressed itself in Newfoundland and Labrador cod fisheries. Second, answers provide a standpoint to explore patterns of society-nature relations that existed before the onset and development of managerial ecology in the cod fisheries. Third, they permit an exploration of the possibilities that currently exist to move beyond managerial ecology in Newfoundland and Labrador cod fisheries.

## 1.5 Chapter Summaries

The remainder of this dissertation is divided into three main sections—methodology and literature review; case study; and discussion and conclusions. Chapter two provides a description of the methodology and theory used to answer the research questions as well as the research process that was undertaken. Chapter three places natural resource management in historical perspective. It gives background information on the major changes that have occurred in the rhetoric and practice of natural resource management and offers a broad theoretical context for the discussion of cod fisheries management in Newfoundland and Labrador.

Chapters four, five, six and seven describe the cod fisheries management case. Chapter four traces the birth and development of managerial ecology in the cod fisheries up to the spectacular collapse and the moratorium on cod fishing that was declared in 1992. Chapter five introduces and begins to describe three main managerial responses to the cod fishery that have developed since the 1992 moratorium on cod fishing. It documents a shift in emphasis from single species population management to ecosystem-based fisheries management (EBFM) and discusses some of the tensions and debates that are becoming apparent among advocates of the ecosystem approach. Chapter six continues the exploration of post-92 cod fisheries management by documenting the changing identity of fishing people as they shift from being represented as ignorant fish killing hunters who frustrate management efforts to professional fish harvesters whose participation is central to new forms of cod fisheries management. The development of industrial cod aquaculture in Newfoundland and Labrador is discussed in chapter seven. Chapter seven argues that even though industrial cod aquaculture raises numerous socio-economic, ethical and ecological concerns its development has been seductive because it promises finally to deliver the type of managerial control over, and caretaking of, cod that spawned the cod fisheries management idea and the subsequent rise of managerial ecology in Newfoundland and Labrador at the end of the nineteenth century.

Chapters eight and nine discuss the major findings of the dissertation and address the question of alternatives to managerial ecology in the cod fisheries of Newfoundland and Labrador. Chapter eight summarizes the arguments in the dissertation critically reflecting on the history of cod fisheries management and how it has responded to the collapse of the wild fishery with a rearrangement of control, caretaking and coping forms of management. Chapter nine focuses on three main challenges to managerial ecology in the cod fisheries. First, the lessons of complex systems theory and the ecosystem approach are applied to the cod fishery case to explore the limits and possibilities of challenging the practical efficacy of managerial ecology. This is followed by a discussion of the political and normative challenges that can be identified with managerial ecology in the cod fisheries management case. The chapter then concludes the dissertation by recommending that research aimed at strengthening and reinventing managerial ecology be redirected toward a greater understanding of the political and moral ecologies of the Newfoundland and Labrador cod fisheries and of other environmental issues worldwide building on insights from complex ecological science.

# CHAPTER 2

## Methodology, Theory and Research Process

This chapter provides a description of the methodology and theory used to answer my research questions as well as the methods used and activities undertaken in the overall research process. The chapter is divided into two main sections. In the first section I outline the methodological and theoretical framework that I applied to understand managerial ecology in Newfoundland and Labrador cod fisheries. I present the constructivist philosophical position adopted in this study and discuss the importance of complex systems theory and critical theories of management in structuring my research approach. The second section describes how I gathered, analyzed and synthesized the information that was collected during my research activities. I discuss the case study approach to research and why I chose to explore managerial ecology in the Newfoundland and Labrador cod fisheries. The chapter concludes with a description of the research methods applied to the case and a summary of the research activities I undertook from 2001-2004.

### 2.1 Methodological Framework

In order to understand cod fisheries management as something that is neither inevitable nor given in the essential nature of things this dissertation operates from a constructivist methodological position. Constructivists understand ideas, concepts and various kinds of persons, species and objects as coming into being and developing within specific historical, relational and material contexts (Hacking 1999). Constructivism is useful for the purposes of this dissertation because so much of the contemporary discussion around cod fisheries management assumes a staunch realist position—that cod, fishers and fishing have always been managed, in one way or another, and that new and improved managerial techniques hold the only viable solution to the cod fisheries collapse.

In his book, *The Social Construction of What?*, Ian Hacking (1999:19) presents a theory for tracing constructivist commitments based on three claims: "1) … the claim that X is not inevitable; 2) that X is a bad thing; and 3) that the world would be a better place without X." Hacking describes six grades of constructionism—historical, ironic, reformist, unmasking, rebellious and revolutionary—based on the strength of reactions to the above three claims.

*Historical* constructivists focus on the first of the claims without necessarily making any normative judgments, presenting a history of X and arguing that "X has been constructed in the course of social processes" (Hacking 1999:19). *Ironic* constructionists argue that the history of X is historically contingent, produced through a specific series of social events and forces, and yet is something that we must treat as if it were a fixed "part of the universe in which we interact with other people, the material world, and ourselves" and therefore not worth making normative judgments about (Hacking 1999:20).

*Reformist* and *unmasking* constructionists emphasize that X is a product of social and historical forces and make normative claims that X is a bad thing that can and ought to be changed. Reformists seek to do this by making X "less of a bad thing" while unmaskers seek to undermine X by exposing the function it serves for powerful interests in order to "strip it of a false appeal or authority" (Hacking 1999:20).

*Rebellious* and *revolutionary* constructivists maintain that X is a product of social and historical forces, that it is bad and that the world would be better off without it. Whereas the rebellious constructivist stays within the world of ideas with respect to criticism, revolutionaries become actively involved in seeking to "change the world with respect to X" (Hacking 1999:20).

Answers to my dissertation questions appear along a continuum from historical through reformist to rebellious constructivist positions with respect to managerial ecology in the cod fisheries. These positions situate the idea of cod fisheries management within the social *and* biophysical contexts of Newfoundland and Labrador at various moments in history. In adopting these constructivist positions, I have been most concerned with avoiding a historically naïve realist stance that posits cod fisheries management as a universal natural category. Adopting the stance of a historical constructivist in chapter four, I argue that the idea of cod fisheries management in Newfoundland and Labrador is relatively new and that it can be traced to specific historical conditions that emerged toward the end of the 19$^{th}$ century. Shifting to the standpoint of a reformist constructivist in chapters five, six and seven, I discuss the many proposals that have emerged to restructure cod fisheries management to make it "less of a bad thing" in the aftermath of the cod fisheries collapse in 1992. Finally, in the concluding chapters of the dissertation I adopt a rebellious constructivist position presenting normative as opposed to descriptive arguments against managerial ecology in the cod fisheries. By using these three different constructivist positions and highlighting both social and biophysical contexts I aim to present a nuanced description of managerial ecology in the cod fisheries that avoids both extreme realist and idealist philosophical stances.

## 2.2 Theoretical Framework

Since I chose to operate from a constructivist methodological position it was crucial that I developed a theoretical framework that would allow an understanding of managerial ecology in the cod fisheries permitting: 1) an examination of the historical character of the management idea in the cod fisheries and the context from which it emerged; 2) a description of how cod fish, fishing and fishing people became conceptualized as manageable and how the meaning of manageability and the targets of management in the cod fisheries changed over time; 3) an explanation of how functional and normative challenges to manageability were responded to in the cod fisheries and how these responses shaped the character of the alternatives that emerged.

Following Carolyn Merchant's definition of managerial ecology (1980), the etymology of the term "management," and an analysis of the evolving practices and discourses within natural resource management, I developed an understanding of the multiple meanings of management and how they operate within contemporary managerial ecology (see Chapter 1.2 and Bavington 2002). I traced out a broad picture of the various management meanings as I found them expressed in natural resource management texts and practices and then explored their unique expression in the cod fisheries management case. This understanding of management was supplemented with theoretical insights from complex systems theory, critical management studies, the philosophy of science, science and technology studies, political ecology and environmental ethics[1].

The above theoretical approaches were further developed by applying them to the cod fisheries management case study. This was an iterative process that continued

[1] The importance of these theories to my dissertation project are outlined below and are described in greater detail in the historical review of natural resource management presented in chapter three.

throughout the research project. At the end of this process I applied two fundamental critiques to the idea of management to begin exploring alternatives to managerial ecology. The first critique looked at the functional practicality of management in the cod fishery by drawing on complex systems theory as expressed in a version of the ecosystem approach (Kay *et al.* 1999). The second interrogated the normative-political status of management with critiques that emphasized management's oppressive immoral and anti-democratic character. Below I outline in greater detail the most influential theoretical perspectives that guided my research.

In his book *Science in Action*, Bruno Latour (1987) argues that to understand science, engineering and management it is important to explore how it is practiced and the conditions needed to maintain its efficacy. He describes how natural, social and managerial scientists achieve their seemingly magical abilities to master the world through the construction and maintenance of heterogeneous networks. These networks allow control from a distance and include a circuit where stable, mobile and combinable representations of the world are sent back to centers of calculation where decisions are made on how to achieve instrumental interventions.

Petter Holm (2001) applies the ideas of Latour to come up with his own theory of fisheries management. Holm argues that fisheries management involves two sorts of work: The work of representation that is done by fisheries scientists and the work of intervention done by states. Holm (1996) describes how marine fisheries management was not able to become fully operational until representations from fisheries biology and the right of states to intervene in fisheries within a nationalized 200 mile exclusive economic zone came together and were institutionalized. He highlights the ongoing negotiations on the *United Nations Convention on the Law of the Sea—UNCLOS* (UN 1982), as being instrumental in this institutionalization process.

Under the December 10, 1982 UNCLOS agreement scientists were charged with producing empirically informed knowledge of commercially exploited fish stocks that would make it possible for state managers to make rational decisions with regard to the utilization of fisheries resources. Science produced the representations that determined how much fish was in the sea, how much could be taken by commercial fleets and how fish stocks could be made optimally productive by controlling fishing effort. Once this was achieved it was up to nation states to intervene in the fishery to calibrate fishing effort bringing it into line to achieve optimal production from commercially relevant fish stocks. The work of representation and the work of intervention that constitute fisheries management are tightly integrated in this process and rely on the predictive ability of science to produce causal models of the fishery. These models reveal levers that can be manipulated the most important of which is fishing effort.

Fisheries management relies on the legitimacy and efficacy of scientific representations of fish that enable state managers to control and carefully use fisheries resources. Therefore, any challenge to, disruption, or failure of these scientific representations threatens to undermine both the legitimacy and efficacy of managerial ecology in the cod fisheries. It was the potential for challenging and disrupting managerial ecology that drew me to insights from complex systems theory and the associated theories of post-normal science and the ecosystem approach.

Complex systems theory has the potential to significantly challenge managerial ecology by pointing out that reductionist Newtonian science, and the Cartesian and

Baconian Enlightenment project of commanding and controlling nature, have inherent limits. Within complex systems theory, post-normal science and the ecosystem approach Rene Descartes' plea (*quoted in* Oelschlaeger 1991:87) for European men to become the "masters and possessors of nature" is now recognized as a form of patriarchal arrogance and hubris that ends up producing fragile and degraded ecosystems. Francis Bacon's call (*quoted in* Glacken 1973:474) for scientists to enlarge "the bounds of human empire, to the effecting of all things possible" is increasingly seen as impractical due to the inherent limitations associated with predicting and controlling complex self-organizing adaptive systems. Developments within ecological science have largely undermined the legitimacy of managerial ecology by questioning the assumptions embedded in the Newtonian model of the universe – assumptions that permitted the belief in certain knowledge and the ability to control and husband nature as if it were a machine.

Ecological science increasingly draws on post-Newtonian models, metaphors and methods which focus on the science of complex systems. Complex systems science understands reality as a nested collection of adaptive ecological systems that are in constant evolutionary flux with periods of rapid change and domains of fragile, adaptive stability (Capra 1996, Levin 1999). This new scientific paradigm focuses on complexity, uncertainty and limits to predictability and control. It calls on natural resource managers to recognize the *necessity* of coping with irreducible uncertainty and adapting to complexity in dynamic and interconnected ecosocial systems (Thompson and Trisoglio 1997, Berkes and Folke 1998, Mitchell 1997, Ludwig 2001).

Complex systems theory presents a different worldview from that of Descartes, Newton and Bacon. Katherine Hayles (1991) contrasts Newtonian and Post-Newtonian scientific paradigms with the metaphors of the clock and the waterfall.

> Whereas the Newtonians focused on the clock as an appropriate image for the world, chaos theorists are apt to choose the waterfall. The clock is ordered, predictable, regular and mechanically precise; the waterfall is turbulent, unpredictable, irregular, and infinitely varying in form. The change is not in how the world actually is – neither clocks nor waterfalls are anything new – but in how it is seen (Hayles 1991:8).

Complexity, as Sardar and Ravetz (1994: 565) note, "has demolished the notions of control and certainty in science." With the disintegration of Newtonian science and its focus on simplistic control and universal certainty has come a science that emphasizes the necessity of coping with complexity and universal irreducible uncertainty. Science must now "characterize and cope with uncertainty rather than…roll back the frontiers of ignorance" (Walter-Toews *et al* 2003:26). This insight challenges the role of scientific inquiry because "in cases of high uncertainty we should…describe and understand instead of seeking to explain and predict" (Ramos-Martin 2003:395).

These changes in science have important implications for the meaning, theory and practice of managerial ecology. My initial belief was that the rise of a post-Newtonian complex ecosystem science would automatically result in the wholesale rejection of the idea of managerial ecology encouraging a return to the pre-modern world-view where, following Merchant (1980), nature would be understood as a living organism whose ways must be followed and respected as opposed to a source and sink for resources and wastes. However, the arrival of post-Newtonian complex ecosystem science has not resulted in a clear break with reductionist Newtonian science and the Cartesian-Baconian Enlightenment project aimed at commanding, controlling and caretaking a world of resources. When complexity has been discovered in nature, the consequences for managerial ecology have differed depending on whether the observer understands complexity to be epistemological and therefore ultimately reducible, or ontological—an irreducible metaphysical condition (Kwa 2002). Epistemological understandings claim that what appears to be complex, uncertain and ultimately unknowable is actually complicated and muddled – further research, additional data and improved models will reveal law-like order, mechanical structure and design principles amenable to control and re-engineering, in what appears initially as irreducibly complex and uncertain (Hayles 1999, Kwa 2002). According to epistemological perspectives, complexity is not a fact of nature, but a reflection of the deficiencies of the observer and their tools. The argument follows that if complex reality is studied long enough and at the right scale, an underlying Newtonian mechanism will emerge with causal laws that can be predicted and ultimately controlled (Rasch and Wolfe 1999, Kwa 2002). Ontological understandings of complexity present complexity as an irreducible fact of nature. This leads to the recognition of absolute limits in the ability to control and steward complex systems—leaving would-be managers with no other choice but to cope and adapt to this reality without the promise of regaining control in the future— and breaking the relationship between representations and instrumental interventions described by Holm (1996, 2001, 2003) and others (Latour 1987, Law 2001) as being central to the efficacy of management.

In addition to the etymology of management, I combined the above theories of management to produce an interpretive device that I could use to understand the operation of managerial ecology in the Newfoundland and Labrador cod fisheries permitting a perspective that would allow me to think before and beyond managerial ecology. In reflection on the above theories of management and complexity several things became clear to me. First, it became evident that representations that permit instrumental interventions aimed at achieving control over and careful use of managerial targets need to be identified and their histories explained as active processes that require work to develop and maintain. Objects are not manageable by nature, they must be represented as such by human beings interested in controlling and carefully using parts of nature represented as resources. In the cod fishery this took a long time and relied on changes to the very nature of fisheries biology as a discipline as it came in contact with the demands of state administrators. As I describe in chapter four, biology had to be modernized, turned into a normal scientific discipline involved in puzzle solving within the population paradigm. Second, moments when scientific representations fail to produce manageable objects amenable to control and caretaking can be identified in natural resource management when the language of coping emerges. Third, the recognition of coping does not necessarily signify the end of management, rather it prompts the need for further exploration of how complexity is understood and what objects are deemed ontologically complex and which are deemed epistemologically complex or merely complicated. The emergence of coping discourse in natural resource management signifies a break down in normal scientific representations that holds ambiguous potential.

Complex systems theory, post-normal science, the ecosystem approach—and the coping forms of management they all tend to promote—all reveal ambiguous lessons for managerial ecology. They point both to a reformation of management processes (new representations permitting instrumental intervention on a variety of new targets using novel means) as well as possibilities for radical breaks from the narrow problem-solving orientation of managerial ecology with the potential to fundamentally call into question current patterns of eco-social order. If the complexity of management targets is understood ontologically the ability to control and carefully use breaks down and the dream of regaining control and caretaking ability is shattered. Once the efficacy of management as control and caretaking has been challenged a space is cleared to imagine alternatives. Coping under this scenario can become a form of practical learning oriented to discovering how to live within a system that is beyond human control and stewardship. If, however, complexity is understood epistemologically then a new round of management as control and caretaking can begin and complexity ceases to be a fundamental critique of managerial ecology. Coping, in this managerial context, acts as a provocation for further scientific research to determine how to regain control and caretaking abilities. In the case of epistemological interpretations of complexity management can still be challenged, but the critique needs to be framed on normative-political rather than functional-efficacy grounds.

Normative-political critique focuses on the immoral, oppressive and anti-democratic character of managerial ecology irrespective of the efficacy of management by highlighting the problematic nature of managerial ecology's utilitarian, means-ends, instrumental rationality. In chapter three I outline the dominant responses to this critique within natural resource management focussing on the move toward participatory natural resource management and shifts away from anthropocentric toward ecocentric environmental ethics. I argue that just as the challenge of complexity has been primarily interpreted narrowly as a challenge requiring better scientific knowledge and new forms of control and caretaking, normative-political critiques have also been largely co-opted within a new mode of managerial ecology distinguished by its reliance on markets over central state-based management mechanisms.

In order to determine exactly how complex systems theory and normative-political critiques of management are produced, interpreted, and responded to I realized that a detailed examination of specific instances of managerial ecology was crucial. This is what motivated my desire to explore the specific case of managerial ecology in the cod fisheries of Newfoundland and Labrador in the detail that is presented in this dissertation. The final sections of this chapter describe the personal motivation for my research into the cod fisheries management case, outline the methods I used, and detail my research process.

### 2.3 Personal Motivation for Case Study

I chose to explore managerial ecology in the cod fisheries of Newfoundland and Labrador for personal as well as scholarly reasons. I have been trying to understand the history of managerial ecology since my undergraduate thesis research (1994) when it became apparent that within environmental studies managerial discourse and practice had become increasingly hegemonic. Growing up in Northern Newfoundland I was also aware of the role management interventions played in the cod fishery, and how despite intensive management the cod fishery seemed to be in continuous crisis. I remember being able to fish for cod for personal consumption unrestricted from the shore in the town of St. Anthony, where I grew up, on Newfoundland's northern peninsula. When the cod fishery moratorium was declared in 1992, I was completing my first year of university in biology. It seemed unbelievable to me that fishing for cod for food would become an illegal activity. The event triggered a desire to understand the underlying paradigms of human-nature interaction that led to the collapse.

Under the influence of the cod fishery collapse I wrote an undergraduate honours thesis that explored three human-nature paradigms (Domination Over, Management of, and Partnership with Nature) and entered a masters degree in environmental studies at York University to continue studying environmental philosophy as it related to managerial ecology. After graduating from York and working and studying in the field of conservation in Pakistan, England and the Southwestern United States from 1997-1999 I became interested in the promise of complex systems theory as expressed through the ecosystem approach. The ecosystem approach appeared to question management and the connection between science and the exploitation of nature in very fundamental ways. I decided to attend Wilfrid Laurier University and the University of Waterloo to study with experts in complex systems theory and the ecosystem approach.

### 2.4 Case Study Research Methods

During my doctoral research (2001-2004) the status of the northern cod stocks and the approach taken toward cod fisheries management in Newfoundland and Labrador changed significantly. The most critical events during this period were the indefinite closure of the cod fishery in the Spring of 2003 in most parts of Newfoundland and Labrador, the subsequent recommendation for cod to be listed as an endangered species, and the rise of industrial cod aquaculture research and development. Since I felt that it was crucial that I kept aware of all these ongoing developments, I moved back to Newfoundland and Labrador to immerse myself in fisheries issues. I then combined a series of qualitative research methods and data gathering activities to obtain an understanding of how cod fisheries management historically developed, how it evolved since the commercial and biological cod collapse, and how cod aquaculture was influencing the idea of the manageability of cod and fishing people. The research was broad in scope and aimed at achieving a breadth of understanding of managerial ecology as it was being expressed in the cod fisheries as opposed to solving a specific problem in the field of natural resource management.

When I began to explore cod fisheries management many social and natural scientists had already produced a variety of studies identifying what the major problems in the cod fishery were and their proposals to fix them. My research, therefore, took place within a field that was heavily studied and I felt that given my interest in exploring managerial ecology in the cod fisheries it was important to study these "solutions" and expose them to critique as much as the original cod collapse crisis itself. I used three main methods to achieve this including archival research on the history of cod fisheries science and management, policy and media analysis of documents related to cod fisheries management, and participant observation in cod fishing and aquaculture communities, at fisheries management meetings, trade association conferences, and during informal discussions on cod fisheries management issues with key informants.

The *Centre for Newfoundland Studies* and the *Marine Institute* library at Memorial University in St. John's, Newfoundland served as the primary site for my archival research into the history of cod fisheries science and management. I consulted and researched newspaper clippings, policy documents, government reports, trade publications, interviews with fishermen and women, academic fisheries management literature, and audio and video footage of the cod fishery at these locations.

Since cod fisheries management issues continue to be debated regularly in the local media in Newfoundland and Labrador, and new fisheries management policies were produced by the Federal government during my research that caused significant debate in Newfoundland and Labrador, I paid close attention to the local media. Editorials in local papers (*The Evening Telegram*, *The Express*, *The Packet*) as well as the daily *Fisheries Broadcast* on CBC radio provided a steady supply of information and opinions on cod fisheries management issues from fishing people, fisheries managers and other interested observers.

Field visits to fishing communities, observation and participation in a significant number of fisheries management meetings and conferences supplemented with more in-depth discussions with key informants in cod fisheries science and management composed the most revealing part of my research. This field research was facilitated and influenced by my involvement in a number of different research communities and roles. Over the course of my research I became involved in the cod fisheries management "community" attending meetings of the Fisheries Resource Conservation Council (FRCC), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the Fish, Food and Allied Workers Union (FFAW), and Federal and Provincial government hearings where I both listened and participated in the discussions. My research was facilitated and shaped by my involvement in two national research projects (*Coasts Under Stress* and *AquaNet*) and a local environmental group of which I became a founding member (*Fisheries Recovery Action Committee*). *Coasts Under Stress* (CUS), *AquaNet* and the *Fisheries Recovery Action Committee* (FRAC) addressed a variety of cod fisheries management issues in Newfoundland and Labrador from extremely different perspectives.

The *Coasts Under Stress* (CUS) research project provided office space, access to interview archives and key fisheries science and management informants for my research activities in Newfoundland and Labrador including partial funding for a field visit to the small (population 50) fishing community of Gilbert Bay, in south-western Labrador in the Fall of 2001. CUS was a large interdisciplinary research project spanning university departments and researchers from Canada's east and west coasts and was jointly funded by the Social Sciences and Humanities Research Council and the Natural Sciences and Engineering Research Council of Canada. CUS had a practical policy orientation to address ecological and social restructuring and the socio-ecological health of rural coastal communities. The five year project was focussed on developing policy recommendations in the broad public interest as well as obtaining knowledge for its own sake along more traditional scholarly lines. The discussions and research approaches that occurred within CUS shaped my understanding of how cod fisheries management discourse and practice were developing in Newfoundland and Labrador particularly the major views of academic researchers to what was wrong and what needed to change vis-à-vis fisheries management.

My participation as a network researcher in *AquaNet* offered a different experience from that of CUS. I was able to access cod aquaculture researchers and development facilities in Newfoundland and British Columbia and became a part of a Canadian research network with the expressed goal of helping to enhance economic development, competitiveness, innovation and sustainable growth in Canada's industrial aquaculture sector. At *AquaNet* conferences and in the vast majority of the funded projects, an applied commercial orientation dominated.

My involvement in the Fisheries Recovery Action Committee (FRAC) added an activist bent to the large-scale research experiences in CUS and *AquaNet*. The creation of FRAC and my involvement as a founding member was made possible due to the fact that in Newfoundland and Labrador there is a lack of third sector activity in discussions around cod fisheries management and aquaculture. Activity by environmental non-governmental organizations (ENGOs) in cod fisheries management discussions is very limited in large part due to lingering negative associations among fishers and the broader Newfoundland public towards environmental organizations. These negative associations are due to continuing animosity surrounding the anti-seal hunt campaigns that were originated during the 1970s by groups located outside Newfoundland and Labrador such as Greenpeace, the International Fund for Animal Welfare and the Sea Shepherd Society. While there were a variety of public processes on cod fisheries management issues that were open to input from environmental groups, meetings were mostly dominated by fishing and aquaculture industry participants, bureaucrats from the provincial and federal government, and individuals representing small inshore fishing groups and the three co-operative fish plants that operate on the island and in Labrador. Starting in 2002, my involvement in the local environmental group the Fisheries Recovery Action Committee (FRAC) provided an avenue not only to attend but to participate in discussions involving the development of industrial cod aquaculture in the province and the impacts caused by industrial fishing technologies at various government, industry and academic meetings and conferences throughout 2003-2004.

My research activities, therefore, were experienced through the lens of three different organizational perspectives—as an academic researcher involved in a large scholarly research network (CUS), a network researcher part of an industry-oriented Canadian Centers of Excellence research network, and as a member of a small local environmental activist based organization.

### 2.5 Case Study Field Work

My research began in 2001 with a *Coasts Under Stress* funded research trip to Gilbert Bay where I lived with a local family, conducted informal interviews on community views on a proposed marine protected area to protect a local bay stock of cod and assisted in completing a research study on the identification of a bay stock of cod and the potential for wild cod grow-out aquaculture in the bay. This experience gave me insight into the perspectives of local people towards cod fisheries management and aquaculture as well as emphasizing the continuing importance of both commercial and subsistence fishing and hunting. It also provided me with a sense of the distance between fisheries managers and the everyday activities that occurred in the community as well as the changes in income distribution brought on by the replacement of the cod fishery by snow crab and shrimp fisheries. It emphasized to me the power of management to control central aspects of fishing people's lives from a distance and the precarious nature of this power when people lose faith in its efficacy and legitimacy. This community-based research contrasts with my attendance at the annual meeting of *AquaNet* in Halifax in

2001 and in subsequent years where I experienced the view of the aquaculture industry and the close links the industry had established with federal government regulators.

In 2002, I began attending Fisheries Resource Conservation Council (FRCC) meetings that were examining the conservation requirements of the last remaining viable cod stock on Newfoundland's southeast coast in Placentia Bay. Further immersion into fisheries management issues occurred at the Fisheries, Food and Allied Workers Union and Professional Fish Harvester's Association sponsored *Fisheries Forum* that I attended along with inshore fishing people in the community of Renews along the Southern Shore of the Avalon Peninsula, about one hour's drive south of St. John's. At this meeting I was surprised to learn about plans by the provincial government to expand experimental fisheries into sculpin and jellyfish, both species that are extremely low trophic feeders and was struck by the professionalization discourse being attached to fishing and fishing people as part of a plan to download increasing management tasks onto the fishing industry.

In 2003, I conducted the bulk of my field research and shaped the major ideas and themes developed in the dissertation. I attended a number of *Fisheries Resource Conservation Council* (FRCC) meetings where the state of the cod stocks in different areas around the island was emphasized and ongoing frustrations by inshore fishers over cod by-catch in other fisheries and foreign over-fishing of cod and other species were expressed. The state of the cod stocks was manifest in the Federal Fisheries Minister's indefinite closure of all northern cod fisheries in April of 2003. My involvement in aquaculture related conferences, interviews with aquaculture industry representatives, provincial Department of Fisheries and Aquaculture employees and Federal Department of Fisheries and Oceans officials imparted the impression that cod aquaculture was being seen as a major solution to the problems associated with the wild cod fishery. During 2003, I was also exposed to critiques of cod aquaculture and the indefinite closure of the cod fishery from inshore fishers who expressed concerns that fisheries management policies were in effect a way to remove fishers permanently from the water, and that the closed food fishery would never be allowed to re-open if cod were officially declared an endangered species.

In 2004, I completed my research and started to write my dissertation. I did, however, continue to be involved in discussions around cod aquaculture alternatives and was surprised by the continuing level of resistance to listing cod as an endangered species at public meetings that I attended on the issue. It was clear to me that there was a complete lack of trust of scientific assessments of cod abundance inshore and of the ability and willingness of the Canadian government to stop foreign and Canadian fishing offshore. Fishers claimed at the public meetings I attended and in a variety of media interviews that offshore fleets were catching large amounts of cod by-catch and disturbing cod habitat thereby severely hampering wild cod recovery.

Table 2.1 provides a summary of the relevant field visits, discussions, meetings and conferences I attended to gather dissertation related research materials and the experiences that shaped my understanding of managerial ecology in the cod fisheries of Newfoundland and Labrador. These activities were combined with theory to construct the understanding of managerial ecology that is presented in the chapters that follow.

**Table 2.1** Field visits, discussions, meetings and conferences attended during my dissertation research.

| | |
|---|---|
| **2001** | • Field visit, Gilbert Bay, Labrador. (Cod aquaculture research assistance and discussions with cod, crab and shrimp fishermen).<br>• *AquaNet* Annual Aquaculture Research Meeting, Halifax, N.S. (Participant observation). |
| **2002** | • Fisheries Resource Conservation Council Public Meeting on 2002/2003 Conservation Requirements for 3Ps Cod Stocks, Sunnyside, NL (Participant observation).<br>• *2002 Fisheries Forum: Fisheries Issues and Opportunities,* Fish Harvesters' Resource Centres, Renews, NL. (Participant observation). |
| **2003** | • Fisheries Resource Conservation Council Public Meeting on 2003/2004 Conservation Requirements for 2J3KL Cod Stocks, St. John's, NL (Participant observation).<br>• Northern cod closure announcement by Canadian Minister of Fisheries and Oceans Robert Thibault, St. John's NL (Participant observation).<br>• American Fisheries Society Conference, Quebec City, PQ (Presenter and discussions with cod fisheries scientists).<br>• Field Visit, Fishermen's Co-op, Petty Harbour, NL (Discussions with cod fishermen and aquaculturalists).<br>• DFO Northwest Atlantic Fisheries Center Meetings, St. John's, NL (Discussions with aquaculture policy analyst and fisheries management policy analysts).<br>• Newfoundland Aquaculture Industry Association Meeting, Gander, NL. (Participant observation).<br>• *AquaNet* Annual Aquaculture Research Meeting, Moncton, N.B. (Presented and conducted participant observation).<br>• AquaNet—Aquaculture Law & Policy Conference, Halifax, N.S. (Participant observation).<br>• Species at Risk Act Information Session, Fairmont Hotel, St. John's, NL (Participant observation).<br>• Cod Hatchery Tour, Marine Science Center, Memorial University, Logy Bay, NL (Discussions with cod aquaculture researchers).<br>• Department of Fisheries and Aquaculture Licensing Division Meeting, Newfoundland and Labrador Department of Fisheries and Aquaculture, Grand Falls, NL (Discussions on aquaculture sustainability and licensing issues).<br>• Presentation to the Canadian House of Commons Standing Committee on Fisheries and Oceans, St. John's, NL (Cod aquaculture policy recommendations presented and participant observation of other presentations to the committee).<br>• Presentation to the Workshop on The Georgia Basin Futures Project. University of British Columbia, Vancouver, BC. (Presentation on Complex Systems Thinking, Sustainability and Natural Resource Management with Specific Reference to Cod Fisheries Management in Newfoundland and Labrador as well as discussions with other participants on complex systems science, sustainability and ecosystem approaches).<br>• Department of Fisheries and Oceans meeting on *The Atlantic Fisheries Policy Review: The Participation of Fish Harvesters in Charting a New Direction for the Atlantic Fisheries.* St. John's, NL. (Participant observation). |
| **2004** | • Cod Aquaculture Meeting, Fishermen's Co-op, Petty Harbour, NL (Discussions on cod aquaculture policy and fisheries management).<br>• Department of Fisheries and Oceans Consultation on Listing Cod as an Endangered Species. St. John's, NL. (Participant observation).<br>• Canadian Conference on Fisheries Research (CCFFR) and the Society of Canadian Limnologists (SCL), St. John's, NL (Participant observation).<br>• DFO Fleet Separation Policy Meeting, St. John's, NL (Participant observation).<br>• Meeting with the Deputy Minister of Fisheries and Aquaculture, Newfoundland and Labrador Department of Fisheries and Aquaculture, St. John's, NL (Discussions on cod aquaculture policy and cod recovery strategies). |

# CHAPTER 3

## Natural Resource Management: A Critical History and Literature Review

> Management as an occupation has been the result of a remarkably successful professional project from its humble beginnings in animal husbandry to its present exalted role as the engine of economic progress. Yet, management is in crisis (Clegg and Palmer 1996:14).

> It is probably no exaggeration to say that there is a worldwide crisis in resource management (Holling *et al.* 2000:342).

In the previous chapter, I outlined my approach to the specific case of cod fisheries management, in this chapter I expand and broaden the discussion to include a critical history of natural resource management themes. While natural resource management (NRM) increasingly frames responses to environmental problems, it is paradoxically also identified as a field mired in failure and crisis. The legitimacy of its Newtonian science, state-centered politics, and anthropocentric ethics are being challenged and reconfigured. An examination of its relatively short history reveals that natural resource management rose to prominence as a response to the turbulence and crisis brought on by industrial modernity. Rather than a full scale collapse of the field, current proclamations of crisis and failure indicate a shift in the dominant meanings and practices of natural resource management in response to the challenges of late modernity. Indeed, it seems wise to be sceptical of proclamations of crisis (Holling *et al.* 2000), failure (Cortner and Moote 1999), pathology (Holling and Meffe 1996) and the end of natural resource management (Ludwig 2001) since these declarations have often been used to strengthen and expand new forms of management (Evernden 1993, Parker 2002, Holm 2003, Knights and McCabe 2003).

Natural resource management emerged out of the revolutionary changes brought on by the Enlightenment period and the industrial revolution when newly formed nation states began applying scientific knowledge to try to harness and control nature. In concert with this trend was a parallel effort to apply "social scientific" techniques to human populations in order to render them more legible for state objectives and, increasingly, more compatible with the needs of industrial capitalism. Natural resource management was founded on state-led control over an inert, mechanical nature understood in utilitarian terms as a collection of separate resources lacking intrinsic value (Merchant 1980/2003, Scott 1998, Bryant and Wilson 1998, Cortner and Moote 1999). To be effectively implemented, natural resource management required the simplification of nature and diverse social patterns of human interaction to permit legibility, control and careful use from above and afar (Holm 1996, Scott 1998). As the scientific representation and modeling of natural resources developed in the mid-twentieth century, natural resources and their industrial uses were theorized using equilibrium-based bio-economic models that took into account both the productivity of natural resources and the needs of industrialists for profitable exploitation. Rather than a sole focus on maximizing biologically sustainable yields in forests, fields and fisheries, natural resource managers pursued strategies that combined resource exploitation and profitability objectives with the goal of maximizing economic yields (Botkin 1990, Holm 1996, Cortner and Moote 1999).

After a century of widespread natural resource management applications, the drive for instrumental control has resulted in bio-physically unsustainable and socially unjust outcomes (Sachs 1999). Counterproductive dynamics have been identified that frustrate some of the problems state-led natural resource managers originally set out to solve. In response to the erosion of scientific confidence in predicting complex natural systems, the perception of widespread failures in centralized state-led natural resource management, and questions regarding the legitimacy of anthropocentric environmental ethics, the meaning and practice of natural resource management has begun to shift. It is increasingly framed through the language of coping and adaptation.

The above challenges have provoked three major responses in the field of natural resource management—adaptive, participatory, and ecosystem-based management. These three responses overlap and are interconnected, and all draw on new forms of science, politics and ethics. Adaptive management draws on a new science of surprise to cope with complexity. Participatory management inaugurates new forms of politics that attempt to cope with conflict and the devolution of state-responsibilities onto local communities and self-organizing markets. Finally, ecosystem-based management points toward a new environmental ethic to cope with the problems of anthropocentrism.

This new emphasis on coping, however, does not mean control and careful use have disappeared. While faith in the capacity of natural science to produce knowledge amenable to the prediction and control of complex biophysical systems has waned, control and careful use of human interactions with natural resource systems continues to advance and maintain its legitimacy (Mitchell 1997, Bavington 2002). Rather than emphasizing state-led, expert-based scientific management, NRM theory and practice increasingly invoke the power of local knowledge, stakeholder participation, self-management, and autonomous decision making. Newly enabled actors are now acquiring managerial responsibilities once the exclusive purview of state-based resource management agencies. This reworking of natural resource management has occurred as bureaucratic central planning and the visible hand of the state decline in significance and NRM policies begin to emphasize the innovative power of the market's invisible hand. Furthermore, while the scientific control and careful use of wild species and ecological systems has lost legitimacy, the industrial domestication of plants and animals for industrial agriculture production continues to advance. The manipulation of organisms at the genetic level redefines the meaning and practice of NRM, reorienting control and careful use onto profitable genetic resources.

Contemporary natural resource management is perhaps best conceptualized as a strategically-oriented technical practice that deploys a variety of control, careful use and coping tools applied to a wide range of targets by diverse sets of individuals and institutions (Bavington 2002). The evolution of management thinking has not been a unified progressive project moving from arrogant control and patronizing caretaking to the humble ecologically enlightened stance of coping and adaptation. Rather, practices and dominant meanings of NRM are better understood as contested interventions that shift over time in response to problems raised by previous attempts at managerial solutioneering and the demands of specific eco-social contexts (Ehrenfeld 1978/93, Bavington 2002). Keeping this perspective in mind, the remainder of this chapter describes the emergence of natural resource management, briefly explores its development, and outlines some of the major responses to declarations of crisis and failure in the field. Once natural resource management is located in its specific historical and cultural context, the stage will be set for an exploration of how this particular version of managerial ecology has been developed and played out in the Northern cod fisheries of Newfoundland and Labrador.

## 3.1 Origins and Ethos of Natural Resource Management: Commanding, Controlling and Caretaking a World of Scarce Resources

> Certain forms of knowledge and control require a narrowing of vision. The great advantage of such tunnel vision is that it brings into sharp focus certain limited aspects of an otherwise far more complex and unwieldy reality. This very simplification, in turn, makes the phenomena at the center of the field of vision more legible and hence more susceptible to careful measurement and calculation. Combined with similar observations, an overall, aggregate synoptic view of a selective reality is achieved, making possible a high degree of schematic knowledge, control, and manipulation (Scott 1998:11).

The idea of natural resource management originates in Europe around the end of the eighteenth century when nature and human interactions with nature begin to be dramatically transformed in keeping with an emerging modernist logic. Previous visions, which had viewed nature as a diverse habitat for flora and fauna and a commons for a diversity of subsistence human uses, become conceptualized as a collection of disconnected natural resources whose productivity and use can be efficiently maximized, enclosed, and placed into the market as commodities (Scott 1998). Nature had been used and traded, and access to it regulated long before the onset of natural resource management. But as the modern industrial period accelerated at the end of the nineteenth century, the intensity of the abstract utilitarian logic that state officials and modern industrialists began to envision being applied to nature and human beings became unprecedented in scale and scope, constituting a qualitative shift in the dominant ontology and epistemology of the West (Merchant 1980, Evernden, 1985/93, Oelschlaeger 1991). As James Scott (1998:360) observes, the abstract utilitarian logic of natural resource management became historically distinctive when compared to earlier periods because of the narrowness of its field of vision, the degree of elaboration to which it was subjected, and the extent to which it permitted the imposition of its own logic on the very reality that it observed—"altering the phenomena in question over time so that it in fact, more closely resemble[d] the stripped down, abstract image the lens had revealed."

Natural resource management developed as a technocratic problem-solving activity charged with the task of applying positivist science to deliver practical assistance for state administrators to help them in their efforts to maximize the use of nature. In this view, nature is understood, to use Heiddeger's (1977) illustrative phrase, as a "standing reserve", which consists of collections of productive yet ultimately scarce resources such as stands of trees, wildlife populations and stocks of fish (Bryant and Wilson 1998, Scott 1998, Cortne and Moote 1999, Neimark and Mott 1999). This view of nature permitted a heightened sense of control and caretaking ability, but was extremely reductionist and simplistic replacing the idea of nature-as-commons with collections of separate, economically scarce resources. As Illich (1983:2) explains:

> "Commons" is an Old English word...which, in preindustrial times, was used to designate certain aspects of the environment. People called commons those parts of the environment for which customary law exacted specific forms of community respect. People called commons that part of the environment which lay beyond their own thresholds and outside of their own possessions, to which, however, they had recognized claims of usage, not to produce commodities but to provide for the subsistence of their households. The customary law which humanized the environment by establishing the commons was usually unwritten. It was unwritten law not only because people did not care to write it down, but because what it protected was a reality much too complex to fit into paragraphs. The law of the commons regulates the right of way, the right to fish and to hunt, to graze, and to collect wood or medicinal plants in the forest... When people spoke about commons...they designated an aspect of the environment that was limited, that was necessary for the community's survival, that was necessary for different groups in different ways, but which, in a strictly economic sense, was *not perceived* as *scarce.*

In the eighteenth century, the grasslands which helped to sustain the peasant livelihood and way of life in England and Scotland were enclosed, transforming the commons into a resource on which commercial flocks of sheep could be exclusively raised by landlords for sale in external markets (Thompson 1963, Ross 1998). New forms of poverty and relationships to nature were created through the enclosure movement as peasants were driven from the land into cities where they were forced to become wage labourers and were made increasingly dependent on market commodities (Thompson 1963, Shiva 1993). The enclosure movement, in combination with the development of industrial capitalism, dramatically changed human attitudes toward and interactions with nature. It "became primarily a resource at the service of 'enterprises' which, by organizing wage-labor, transformed nature into the goods and services on which the satisfaction of basic needs by consumers depends" (Illich 1983:2). The embedded experience of living in the commons gave way to the disembedded God's eye view of the manager externally controlling and carefully using a quantifiable, abstract world of resources (Livingston 1982, Evernden 1993).

The managers' abstract forest and fishery could not be the same as the commons inhabited by indigenous forest dwellers or peasant fishing families. Even if all the ecological interactions at play in the forest or ocean were known by the manager, they would still "constitute a reality so complex and variegated as to defy the easy shorthand descriptions" that were needed to ensure a continuous flow of board feet, fish protein and profits from the land and sea (Scott 1998:22). Representations of nature and patterns of subsistence forestry and fishing that relied on the commons had to be changed if they were to become manageable.

> If the natural world, however shaped by human use, is too unwieldy in its "raw" form for administrative manipulation, so too are the actual social patterns of human interaction with nature bureaucratically indigestible in their raw form. No administrative system is capable of representing *any* existing social community except through a heroic and greatly schematized process of abstraction and simplification (Scott 1998:22).

The conditions for the many processes of abstraction and simplification constitutive of natural resource management emerged during the Enlightenment period with the rise of Newtonian mathematics, the Baconian scientific method, Cartesian philosophy, industrial capitalism, and the centralizing state-making activities of modernity (Merchant 1980, Scott 1998). In *The Death of Nature*, Carolyn Merchant (1980) describes how NRM evolved out of a particular Western history tied to Christianity—a history originating with British biblical reinterpretations in the early eighteenth century (Merchant 1980). Out of the disorder of post-revolutionary England, biblical passages were reinterpreted to help legitimize the creation of a new social order necessary for entrepreneurial advance and the expansion of market society (Merchant 1980:248-9). Reinterpretations of biblical texts in the early eighteenth century constructed God as "a caretaker, steward, and wise manager of his entire created world" (Merchant 1980:251). Through these biblical reinterpretations, the idea of "God-as-universe-manager" came to serve as the model for "humans-as-managers-of-the-earth" (Merchant 1980). During this time, the pre-modern view of an alive, organic nature providing a fluctuating but ultimately fecund source of free gifts such as trees, fish, water and air for human use was slowly replaced by a dead, mechanistic nature. This version of nature was understood in the image of a factory producing predictable but ultimately economically scarce supplies of discrete quantifiable objects (populations, stocks, stands, resources) which could be scientifically described, enclosed as property, controlled through ownership and thereby subjected to caretaking and stewardship (Merchant 1980).

The modern reinterpretation of nature as a collection of dead mechanical objects, rather than a living organism, removed moral constraints on use and permitted increased exploitation (Merchant 1980/2003, Evernden 1993). In tandem with these developments the need for new social orders following the breakdown of feudalism and emergence of industrial capitalism encouraged top-down politics aimed at strengthening centralizing states (Paehlke and Torgerson 1990). Flowing from discoveries and arguments made in science, philosophy and political economy that helped to create the conditions for the emergence and expansion of capitalist market society (Polanyi 1957) a small group of human beings was charged with the management of the earth. These historic developments empowered and liberated some members of society (primarily male property owners, scientists and political leaders) and widely dispersed some species (mainly domesticated plants and animals and their associated biota) while denigrating and enslaving others (women, workers and colonized peoples and many endemic wild species and habitats) (Crosby 1993, Sachs 1993, Shiva 1993, Foster 2000). While they were unevenly distributed in their impacts and widely contested, these modern developments resulted in a revolutionary transformation in the relationship between humans and the earth. This created a confident control and caretaking ethos for natural resource managers to realize René Descartes' (*quoted in* Oelschlaeger 1991:87) vision for humans to become the "masters and possessors of nature" and Francis Bacon's (*quoted in* Glacken 1973:474) plan for scientists to enlarge "the bounds of human empire, to the effecting of all things possible."

### 3.2 The Development of Natural Resource Management: Refining Control and Careful Use Techniques

While sharing roots with this European history and the development of scientific forestry in Prussia and Saxony (1765-1800), the beginning of North American natural resource management is usually associated with the rise of the American Progressive movement, 1890-1920 (Scott 1998, Cortner and Moote 1999, Neimark and Mott 1999). Under the utilitarian banner of "the greatest good of the greatest number in the long run" and in direct opposition to the preservationists[1], the American conservationist and first chief of the U.S. Forest Service, Gifford Pinchot, wrote that "the first duty of the human race is to *control* the earth it lives upon" (Pinchot 1910:45). Based on a recognition of "modern industry's power to deplete natural resources" NRM developed as a state-led project to protect natural resources from "early, complete, or unrenewable exploitation" (Luke 1999b:132). From the beginning the concern of natural resource management was not to halt industrial growth but to ensure the conditions for its continuous expansion (Luke 1999ab, Sachs 1999).

Parallel to the development of Pinchot's ideas were those of Frederick Winslow Taylor. Taylor's *Principles of Scientific Management*, published in 1911, inaugurated a highly influential scientific management movement aimed at commanding, controlling and husbanding the labour of human beings by separating conception from execution in factory environments. By using time and motion studies and applying scientific principles to the labour processes of Fordist production lines, scientific managers were

[1] The preservationists were led by John Muir [1838-1914] who argued for the aesthetic, spiritual and intrinsic values of nature as opposed to the use-values advocated by Giffort Pinchot. The famous and influential arguments between American conservationist Pinchot and preservationist Muir, at the beginning of the twentieth century, turned on radically different valuations of the role management should play in nature. Pinchot advocated a hands-on maximum-use model grounded in utilitarian scientific resource management, while Muir promoted a hands-off anti-management stance invoking the ideal of wilderness, where wilderness was conceptualized as a place devoid of permanent human presence and influence (Merchant 1996). "The American naturalist John Muir was a fervent proponent and defender of the idea of wilderness, rejecting the idea of an imposed boundary, preferring to see nature as an infinite, boundless entity. As such, the idea of protected areas contradicted his idealized vision of nature as ungraspable or unlimited and consequently boundless. Confining it spatially in a reserve was therefore morally wrong" (Fall 2002:245).

able to maximize the efficiency of mass production (Morgan 1986)[2]. Taylor and Pinchot's ideas were widely embraced across the industrial world throughout the twentieth century, both in capitalist and communist nations, despite significant early resistance in the United States (Saul 1992). Taylor's scientific management was contested by workers and some politicians who branded him and his ideas the enemy of the working man (Shenhav 1999). Management was seen to be depoliticizing the issue of workers' resistance and militancy towards factory work, translating political and moral demands for better working conditions and a greater share in the wealth produced through their labour power into technical problems amenable to engineered solutions addressed within the firm (Shenhav 1999, Hoopes 2003). However, despite this resistance by workers, scientific management gained widespread application across the political spectrum (Braverman 1974). Scientific management was "adapted in varying forms by both the Soviet and the Nazi regimes. Lenin structured his economic reforms on his version of scientific management... Stalin turned it into a Communist truth. The first Soviet Five-Year Plan was drawn up with the help of leading Taylorist advisors imported from the United States. As a result some two-thirds of Soviet industry was built by Americans" (Saul 1992:120).

[2] Taylor's scientific management advocated five basic principles. First, all responsibility for the organization of work was to shift from the worker to the manager. Managers, Taylor argued, should do all the conceptual thinking related to the planning and design of work, leaving the workers with the task of executing the implementation. Second, scientific methods were to be used to determine the most efficient way of doing work and worker's tasks were to be designed accordingly, specifying the precise way in which the work was to be done. Third, once workers tasks were scientifically designed the best person to perform the redesigned tasks was to be selected. Fourth, workers were to be trained to work efficiently and fit into the scientific design of the work process. Fifth, workers performance was to be monitored to ensure that appropriate work procedures were being followed and that appropriate results were being achieved (Morgan 1986:30).

Along similar lines to Taylor, Pinchot's conservation movement suffered ongoing criticism from the preservationist movement of John Muir throughout the twentieth century. Preservationists saw conservation, and the practices of natural resource management it encouraged, as reducing the moral significance and beauty of the natural world to crass utilitarian use and exchange values in the interests of industrialists. The preservationist movement formed the foundations of modern environmentalism in such organizations as the Sierra Club – founded by Muir and his supporters in 1892. The preservationists attempted to frame environmental issues as moral, aesthetic and political conflicts over the appropriate relationship to nature as opposed to a series of technical problems amenable to engineered solutions within the socio-economic, political and moral status quo of industrial modernity (Oelschlaeger 1991). However, throughout the twentieth century it was the conservation movement and the practice of natural resource management that became institutionalized in government departments and ministries around the world (Neimark and Mott 1999).

Emerging out of the European Enlightenment and the American Progressive era, natural resource management continued to develop throughout the twentieth century with the addition of industrial resource users into the scope of management and a broader conceptualization of bio-economic *systems* as opposed to separate natural resources considered in isolation from the needs of industry. During the post World War II period, the insights of economists increasingly joined those of biologists creating a variety of equilibrium-based bio-economic systems models that allowed managers to take into account not only biological productivity, but also profitability (Merchant 1980, Botkin 1990, Smith 1994). Bio-economic models showed how the needs of industry and the regeneration rates increasingly being discovered in renewable natural resource populations of fish, wildlife and stands of trees could be brought into an enduring rational, predictable and profitable relationship (Smith 1994, Cortner and Moote 1999, Luke 1999b). Bio-economic models illustrated the need not only to control nature as a collection of resources and to map out maximum use rates, but also to maximize profitability by carefully stewarding renewable natural resource property and the industries that owned and made use of it (Holm 1996, Cortner and Moote 1999). As managerial thinking developed and the ability to predict and control collections of natural resources expanded, NRM became more clearly associated with careful use and stewardship, as expressed in the idea of maximum economic yield (Smith 1994, Cortner and Moote 1999). Whether it was ecological or economic yields that were to be sustained at the maximum level, a core function of natural resource management was to serve as "an instrument for ordering social and economic conditions, as well as managing the production" of resources in scientifically measured forests, fields and seas (Lee 1984:95).

While natural resource management has traditionally been associated with disciplinary applications of biology and economics, more recently it has included interdisciplinary considerations from a variety of environmental sciences, political science, management studies, law, economics, geography, sociology and anthropology (Wilson and Bryant 1997:16). As with practices associated with managing human labour, the development of natural resource management has increasingly broadened the variety of experts believed to be important in the field. There has been a corresponding expansion of the scope of its concerns, from separate resources to bio-economic systems and more recently the sustainability of entire eco-social systems (Mitchell 1997, Peet and Watts 2004). While natural resource managers have traditionally been employees of government agencies, they now include a wide range of actors located in the private sector and civil society as well (Bryant and Wilson 1998).

Textbook accounts of natural resource management have traditionally focused on "the application of science to specific environmental problems, usually under the auspices of the state" (Wilson and Bryant 1997:6). Ray Rogers (1995) refers to this form of natural resource management as an "on/off switch for destruction" as managers attempt to regulate destructive industrial technologies aimed at maximizing profit within a finite world of biophysical constraints. Rogers (1995) argues that under contemporary capitalist conditions, economic, political and social interests develop dependencies on levels of industrial exploitation that biophysical systems can only withstand for short periods of time. When natural resource managers attempt to halt industrial exploitation at biophysically or economically optimal levels, they face significant resistance from resource users dependent on the high levels of industrial exploitation.

Natural resource management is concerned, therefore, with a contradictory process of both controlling, carefully using and coping with the industrial exploitation *and* protection of resources and their supporting environments. On the one hand, natural resource management advocates a methodology of analysis, planning and development (Mitchell 1979), starting with "goal setting and extend[ing] through the functions of information systems, research, planning, development, regulation and financing" (MacNeil 1971:5). As Garlauskas (1975:190-1) observes, "the essence of environmental management is that through a systematic analysis, understanding and control, it allows man (*sic*) to continue to evolve his technology without profoundly altering natural ecosystems." On the other hand, natural resource management struggles to cope with the side effects of economic and technological development—environmental pollution, endangered species, degradation and generalized scarcity (Sachs *et al.* 1998).

As discussed above, present day definitions of natural resource management are far less confident in explicitly asserting the control and caretaking side of natural resource management and increasingly emphasize adaptation and coping with the effects of industrial development. Natural resource management in contemporary textbooks is described as a collection of tools to help managers "recognize and deal with change, complexity, uncertainty, and conflict" (Mitchell 1997:284). The current switch in emphasis from control and caretaking to coping and adapting rhetoric marks a significant break from the confident language of command and control expressed in Taylor and Pinchot's Progressive-era management.

### 3.3 Crisis and Reinvention in Natural Resource Management: The Focus on Coping and the Development of New Forms of Control and Careful Use

By the 1980's natural resource management scholars and practitioners began to recognize the need to include not only the management of resources and industries but also human beings and their institutions. This trend in natural resource models was accompanied by the emergence of large scale ecosystem thinking, the belief that natural resource management is more about managing people than biophysical nature, and the recognition of increasing scientific uncertainty and limits associated with centralized state-led command, control and caretaking (Peet and Watts 2004). The current vogue in NRM thinking is to highlight the need to include resource users in decision making, reduce control oriented state-led management, and emphasize the self-organizing power of markets. It is argued that by obtaining resource users "buy in" and "ownership" of management plans, enforcement and knowledge gathering costs (increasingly the target of budget-restrained management agencies) can be made more economically efficient and effective (Cortner and Moote 1999, Rose 1999)

This new approach is also marked by declarations of management failure as the twin crises of nature (biophysical sustainability) and justice (equitable distribution) become more apparent (Sachs 1999). The history of natural resource management illustrates a general shift from large scale state-led projects aimed at commanding and controlling natural and social worlds to permit careful use, toward a new emphasis on coping and adapting to global change, complexity, uncertainty, and conflict (Holling and Meffe 1996, Mitchell 1997). Present day definitions from within the field illustrate shifts from a narrow economic focus on controlling resource extraction to ensure rational use to a broader set of tools designed to cope with ecosystem protection and greater public participation, shared responsibility and collaborative management—increasingly referred to as "governance" rather than management[3]. In this process, an increasing number of actors come to be understood as natural resource managers. In addition to natural and social scientists, increasingly nation states, environmental NGO's, transnational corporations, international financial institutions, farmers, fishers, nomadic pastoralists, shifting cultivators, hunters and gatherers are defined as environmental managers. The

[3] Walters notes that "Theorists of governance argue that the age when the state monopolized and was synonymous with governance is passing, the image of authority flowing from a fixed, institutional centre outmoded. Instead, they insist we inhabit a world characterized by governance. As societies have become more complex, and social demands have proliferated, political authority has become polycentric and multileveled. Rule operates not over but in a complex relationship with a dense field of public and private actors. Lines between public and private have become blurred" (Walters 2004:27).

most expansive definitions proclaim that "all can be considered as environmental managers insofar as their livelihoods are primarily dependent on the application of skill in the active and self-conscious manipulation of the environment" (Wilson and Bryant 1997:9).

Drawing on the coping meaning of management, others such as Berkes and Folke (1998:13) assume that natural resource management systems can emerge in all societies under the right conditions: "We assume that every society has its own means and adaptations to deal with its natural environment...In some cases, the capital of local knowledge may be used and organized in such a way that it...amounts to a management system." Critical management scholars argue that these expansive definitions of management and managers should be understood as a consequence of the erosion of confidence in central planning and Keynesian welfare state bureaucracies brought on by the collapse of communism in the former USSR, the rise of neoliberalism, and the specific governance challenges associated with late capitalism (du Gay 1996, Grey 1999, Rose 1999, Jessop 2002, Banjerjee and Linstead 2004, Cooke 2004). The expansive identification of management systems and managers, therefore, must not be taken as a self-evident truth, but rather as a historically and geographically situated phenomenon.

Within the field of NRM the failure to control unsustainable resource use and inequitable development has led to the identification of three major problems that challenge the meaning and practice of management. First, the science of management-as-control, based on the Newtonian worldview, is increasingly shown to be inappropriate for describing the poorly understood, complex, self-organizing, open systems with which managers must increasingly cope (Kay and Schneider 1994, Cortner and Moote 1999).

Second, the politics of centralized state-based administration, through which NRM has historically implemented control approaches based on technical expertise, have been presented as ineffective and oppressive (Peluso 1993, Escobar 1995, Peet and Watts 1996). Third, the utilitarian, anthropocentric ethic which lies at the heart of management-as-control and careful use has been identified as an example of human arrogance and alienation from nature (Ehrenfeld 1978, Evernden 1993). These three problems in natural resource management are framed within the field as examples of the deleterious effects of striving for management as command and control. However, it is perhaps more accurate to understand changes in NRM as a transformation in the individuals, institutions, knowledge and techniques that are presently deemed legitimate and effective in achieving the control and careful use of nature. Recent changes in NRM have transformed the types of social and biophysical targets currently understood as being amenable to control and careful use, and those with which managers must cope. The remainder of this chapter reviews these changes in NRM to prepare for a detailed examination of how they have played out in the Newfoundland and Labrador cod fisheries (*see* Table 3.1).

**Table 3.1** The evolution of responses to problem domains in natural resource management.

| Major problem domains in natural resource management | Natural resource management-as-control & careful use (Crisis) | Natural resource management-as-coping (Response) |
|---|---|---|
| **Science** | Newtonian | Post-Normal Science (Complex Systems Science): Adaptive Management |
| **Politics** | Statist | Local Community & Market: Participatory Management |
| **Ethics** | Anthropocentric | Ecocentric: Ecosystem-Based Management |

### 3.4 Crisis and Reinvention in Natural Resource Management Science

The science of management-as-control and caretaking, based on Newtonian representations of an orderly clockwork universe, has become increasingly inadequate for the description and control of poorly understood, highly variable natural systems and the globally integrated markets into which the resources of natural systems are sold (Kay and Schneider 1994, Cortner and Moote 1999, Jessop 2002). Ecologists focused on the biophysical limits to sustainability and the multiple historic examples of overexploitation, collapse and extinction argue that sustainable natural resource management is impossible.

> Resource management is a discipline whose history is replete with spectacular failures, but whose practitioners seldom change their policies in response to past experience...Such failure is an inevitable consequence of a contradiction between human desires and human capabilities (Ludwig 1993:555).

From this perspective, NRM can never achieve sustainable economic or ecological yields because it is being asked to do the impossible—maintain increasing extraction with technological innovation without an ability to know in advance where to set optimal levels of exploitation or what effects the innovations will have. Large levels of uncertainty associated with natural variability and the impossibility of conducting controlled experiments that allow for generalizations mean it is impracticable to determine optimal exploitation rates with the specificity demanded by the social, political and economic systems of contemporary capitalism (Ludwig *et al.* 1993). Ludwig, Hilborn and Walters (1993:17) argue that "it is more appropriate to think of resources as managing humans than the converse: the larger and the more immediate our prospects for gain, the greater the political power that is used to facilitate unlimited exploitation." These critics point to the impossibility of gaining certain knowledge to allow for a normal science of prediction and control to be applied in a context of insatiable human greed (Ludwig 1993).

In addition to pointing to the impossibility of NRM based on a normal science aimed at predictability and control, scholars increasingly argue that the drive to control exacerbates the problems management is designed to solve, creating new ones.

> As the effects of previous attempts to manage the world become ever-more problematic, so the attempt to manage these effects becomes ever more desperate… What drives rationalization is the contradiction between the inability of human beings to control the world, the stubborn persistence of the belief that such control is possible, and the social conflicts and problems generated by attempts to exert this control (Grey 1996:605)

Critics of natural resource management have also explored how managers are implicated in co-creating, not simply reflecting, the targets of management—resources, environments, ecosystems, and categories of people. As James Scott (1998:339) has noted,

> [It] is not merely a question of inventing measures that accurately reflect the facts on the ground and that can be conveyed by administrators. It is, above all, a question of changing the environment so that it is more standardized to begin with.

Critical perspectives on the preconditions for effective management and the side-effects of managerial intervention draw attention to the interaction between knowledge and power. Scientific knowledge that supports management-as-control has been identified as a central problem (Kay and Schneider 1994, Ravetz 1999). In order for the scientific method to work, an artificial situation of consistent reproducibility must be created out of a complex world (Kay and Schneider 1994). This requires enormous simplification in order to create "targets" for management that are predictable and controllable. However, by reducing complexity at the local scale, and externalizing it at the global scale, conditions are created for unpredictable large scale disturbances and uncontrollable catastrophic events.

Conservation biologist David Ehrenfeld (1991:31) has identified a paradox which results from the application of management-as-control and careful use to landscapes.

> The conservation paradox...is that active management, the kind of management that involves decisions to manipulate environments, is a destabilising process...Active management needs rules; rules are based on generalities, simplifications, and assumptions; and generality is often the enemy of specificity, which is the same as diversity. To put it another way, the more balls you juggle, the more likely you are to drop a few.

Rather than the need for more management, Ehrenfeld concludes that the biophysical environment needs less. Management-as-control is seen as a destructive tool by Ehrenfeld, one that requires processes of simplification that are the enemy of what he wishes to preserve, species biodiversity. Along similar lines, Buzz Holling—the father of adaptive environmental management—has called the goal of control the "pathology of resource management" (Holling 1995).

> Any attempt to manage ecological variables (e.g. fish, trees, water, cattle) inexorably [leads] to less resilient ecosystems, more rigid management institutions, and more dependent societies...the very success of management...set[s] the conditions for collapse. In each case the goal [is] to *control* a target variable (Holling, 1995:6 *emphasis added*).

Management-as-control assumes that problems are well bounded, clearly defined, relatively simple and generally linear with respect to cause and effect. However, the natural world is complex, non-linear, and poorly understood (Holling and Meffe 1996:329)[4]. This disconnection between management theory and the world into which it is applied leads to catastrophic outcomes for those reliant on successful managerial interventions when the power to create an order amenable to prediction and control breaks down (Tognetti 1999). Increasingly, ecologists argue that managerial control and caretaking create the conditions for their own catastrophic failures by seeking to control the variability of their targets, in

---

[4] Holling argues that the Clementsian climax theory of ecological communities, which assumes that natural systems move through a series of predictable seral stages to reach a stable endpoint (Worster 1994), is an invalid description of ecosystems. In place of climax theory, Holling advocates a cyclical figure eight model with stages of exploitation, conservation, release and reorganization driven by different levels of connectedness, stored nutrients and energy (Holling 1995).

order to maximize single variables for narrow economic interests over relatively short time horizons (Holling *et al.* 2000) [5].

Critics, echoing the observations of Ehrenfeld and Holling, increasingly identify paradoxes, pathologies, and limits to the use of management-as-control and management-as-caretaking (Cortner and Moote 1999). This has led to calls for new approaches based on alternative forms of science and a drastic reorientation of the central goal of management from control and caretaking to coping with the natural world.

> Whereas science was previously understood as steadily advancing in the certainty of our knowledge and control of the natural world, now science is seen as coping with many uncertainties (Funtowicz and Ravetz 1993:739)

### 3.5 The Crisis of Control and the Rise of Coping in Natural Resource Management Science

From the perspective of natural resource management-as-coping, the problem with science is that it assumes a linear, mechanistic world that can be totally known. In its place, theorists argue that, in fact, nature is neither linear and mechanistic, nor totally knowable. Nature, while still containing collections of resources (goods and services), is complex, imbuing managerial knowledge with high levels of uncertainty, which in some cases is irreducible (Rosen 2000).

The prevailing image of modern science has been that, given enough information and powerful enough computers, it could predict with quantitative certainty, making the control and careful use of biophysical systems possible (Kay and Schneider 1994). The role of science in NRM has been to provide knowledge to make the control and careful

[5] These failures are disproportionately spread out geographically affecting human and non-human individuals and communities differentially. This recognition stimulates much of the environmental justice literature (Schlosberg 1999, Torgerson 1999).

use of nature-as-property possible. However, there is a growing recognition of irreducible uncertainty, as is particularly evident in complex context-dependent environmental problems that elude control and have in large part resulted from previous attempts at control and careful use (Tognetti 1999).

Alternatives to the Newtonian science of control and caretaking are encapsulated in post-normal science (*see* Table 3.2 *on the following page*). Post-normal science applies to situations where facts are uncertain, values are in dispute, stakes are high, and decisions must be made (Ravetz 1999). Post-normal science removes the Cartesian barriers between facts and values, seeing them as intimately connected. Because of this connection, extended peer communities and extended facts are necessary to allow for all who are interested in an issue to participate (Ravetz and Funtowicz 1999).

Post-normal science illustrates a trend away from control and caretaking as central goals. Shifts away from management-as-control and caretaking are highlighted in adaptive management and the ecosystem approach.[6] Both operate from the metaphor of complex systems to draw attention to self-organizing dynamics, human ignorance, rapid change, uncertainty, and unpredictability. As Grzybowski and Slocombe argue, this shift calls for a toning down of the arrogant belief that management can control and carefully steward the evolution of complex evolving systems.

> He who thinks that he is managing the evolution of a complex system is likely only managing the microscopic fluctuations, the incremental changes—optimizing the details

[6] Ecosystem-based management is conceptually based on an ecosystem approach which: "(i) Describes parts, systems, environments and their interactions; ii) is holistic, comprehensive, trans-disciplinary; iii) includes people and their activities in the ecosystem; iv) describes system dynamics, e.g., through concepts of stability and feedback; (v) defines the ecosystem naturally. E.g. bioregionally, instead of arbitrarily; vi) looks at different levels/scales of system structure, process and function; vii) recognizes goals and taking an active, management orientation; viii) incorporates actor-system dynamics and institutional factors in the analysis; ix) uses an anticipatory, flexible, research and planning process; x) entails an implicit or explicit ethics of quality, well-being, and integrity; and xi) recognizes systemic limits to action—defining and seeking sustainability" (Slocombe 1998:32).

and neglecting to anticipate possible qualitative changes. Then comes the surprise: a staggering realization that the old order no longer works (1988:467).

**Table 3.2** Normal and Post-Normal Science.

Changes in science have been referred to using a variety of categorization. This table adopts the language of normal and post-normal science (Compiled based on Funtowitcz and Ravetz 1993, Ravetz 1999, Hengeveld and Walter 1999/2000 and Merchant 1998/2003).

| | Normal Science | Post-Normal Science |
|---|---|---|
| **Central Metaphor** | Mechanistic (Clock)—Descartes, Newton, Bacon… | Holistic, Open, Complex Systems (Ecosystem)—Prigogine, Koestler, Boulding... |
| **Goal** | Control of natural world | Cope with uncertainty |
| **Core organization** | Dualism, Separation and Hierarchy | Wholeness, Interconnection and Heterarchy (Networks) |
| **Facts and Values** | Facts and Values Separate | Facts and Values linked, cannot be separated |
| **Values** | Presupposed | Made explicit and open for debate |
| **Assumptions** | Predictability, control, one universal Truth | Unpredictability, incomplete control, plurality of legitimate perspectives |
| **Model of Scientific Argument** | Formalized Deduction—Popperian, falsification of hypothesis. Kuhn-Puzzle Solving | Interactive dialogue, confrontation of multiple hypothesis and realities. Funtowitcz and Ravetz-PNS |
| **Knowledge** | Universal—context free, ahistorical (Homogeneity) | Context Dependent, historical (Particularity, difference, heterogeneity) |
| **Emphasis is placed on** | Parts, atomistic | Processes, holistic |
| **Summing** | Linear, whole is equal to sum of the individual parts | Non-linear, the whole is greater than the sum of the parts. Causes become effects in complex nested feedback systems. Emergent properties. |
| **Society** | Sum of individual rational agents who have submitted themselves to rule by the sovereign (Hobbes) | Synergy, the combined actions of separate parts may produce an effect greater than the sum of individual effects. Local and small scale decision making. |
| **Change** | Linear, predictable (Predictions) | Non-linear, chaotic, unpredictable (Scenarios) |
| **Participants** | Experts, Specialists, Disciplinary (Domination of all other ways of knowing by normal science) | Extended Peer Community, Generalists, Inter/transdisciplinary (Co-operative, partnerships with other ways of knowing, including local knowledge) |
| **Certainty/Uncertainty** | Certainty in knowledge and value neutrality. | Radical uncertainty and ignorance that is value laden. |
| **Data** | Emphasis on quantity and using/applying knowledge (Hard Facts, Soft Values) | Emphasis on quality and making ignorance useable (Hard Values, Soft Facts) |
| **Problem Formation** | Problems set and solutions evaluated by experts | Problems set and solutions evaluated by the criteria of broader communities |
| **Systems** | Hard, mechanical, closed, determined | Soft, organic, open, emergent |
| **Underlying Politics** | Authoritarian: Narrow participation and emphasis on expertise | Democratic: Open to diverse ways of knowing and extensive participation |

### 3.6 Implications of the Shift Towards Coping in Natural Resource Management Science

The implication of shifts away from control and caretaking in natural resource management science is that managers must adopt a more humble, cautious approach when proposing active managerial interventions in *biophysical* environments. "It is often presumptuous" Bruce Mitchell (1997:284) writes, "to believe that humans 'manage' environment and resources. More realistically, humans manage their interactions with environment and resources." In practice, the above observations have meant that human behaviour, instead of the natural world, is increasingly targeted for control and caretaking. Indeed a variety of novel control and caretaking techniques now target human beings rather than biophysical or economic systems (Brown 1996, Bavington 2002). Holling and Meffe (1996:335), illustrate this shift in emphasis when they argue that,

> Ironically, our attempts at command and control are usually directed at complex, poorly understood, and non-linear natural systems, rather than at the fundamental source of the problem—human population growth and consumption—where control is viable, reasonable, and could be effective.

The predominant response to perceived crises and failures in natural resource management has been to advocate for a move toward management-as-coping and adapting to the very biophysical systems that were previously targets of control and careful use (Bavington 2002). This shift toward management-as-coping has revolved around the recognition of irreducible complexity in biophysical systems previously perceived as being relatively simple and stable mechanical systems. The recognition of fundamental ignorance in ecologists' knowledge of complex biophysical systems has led resource managers to replace Enlightenment hubris with a renewed sense of impotence.

Recent changes in the science of NRM, however, have not resulted in the end of managerial ecology, rather they have typically shifted managerial interventions onto a new set of targets, which appear simple enough to be amenable to handling, training, control and careful use. Increasingly, resource managers explicitly identify humans and their behaviours, motivations, values, and interactions with natural resources as legitimate and practical targets for control and caretaking. These new targets of management are to be controlled either through direct punitive intervention or by relying on the role of humans as calculating agents operating in designed decision environments. Exemplifying this shift in the field, Bruce Mitchell notes, “We don’t try to manage the resource system, but try to manage human interaction with the resource” (Mitchell 1999). Edward Grumbine (1997: 46) observes: “Resource management decisions are about… manipulating human behaviour rather than physical things.” Similarly, Knight proclaims, “Humans are part of the landscape…and…if *managed*, do not have to be viewed as destructive agents” (1996:473 *emphasis added*).

Resource management scholars increasingly emphasize the risks involved, and the impossibility of, controlling wild ecosystems without harming what you are attempting to protect (Ehrenfeld 1991). To remain relevant and helpful, therefore, management must shift from targeting natural resources, to targeting anthropogenic factors in the resource system that are coded as being relatively simple, predictable or potentially self-organizing. Human attitudes, values, motivations and resource-use behaviours are now reflected in the image of the relatively predictable Newtonian machine (e.g. the neo-liberal rational choice actor), while biophysical systems are increasingly described using post-normal, post-Newtonian complex systems science (Bavington 2002).

The shift explicitly to managing humans in addition to, or instead of, trying to manage biophysical systems has corresponded with significant changes in how economic systems are structured and managed vis-à-vis the state. Central planning, expertise and state-led control have lost moral legitimacy and ideological ground due to the rise of neo-liberalism, the collapse of communism, and the decline of Western welfare states (Rose 1999, Jessop 2002, Parker 2002, McCarthy and Prudham, 2004, Samuel 2004). State-led economic management, neo-liberals argue, creates inefficiencies and dependencies stifling individual freedom, entrepreneurial innovation, and technological advancement necessary to successfully cope and adapt to competitive world markets (Jessop 2002). Furthermore, with the emergence of multinational trade agreements and powerful multinational corporations, state-led bureaucratic control of economic activity has become increasingly impotent and ineffective (Korton 1995, McCarthy and Prudham 2004).

Rather than being managed by the iron fist of the state, economies have increasingly been deregulated and are now managed more and more through the self-organizing invisible hand of the market and private sector corporations. As Nicolas Rose explains, state agencies and politicians now seek to exercise their power by "steering" (setting policies that attempt to change the environment of consumer decision making) rather than "rowing" (delivering services to clients) (Rose 1999:16). As a result of these changes, human beings and elements of biophysical systems formerly reliant on strong government regulations and welfare state interventions must now increasingly cope and adapt to the dictates of the global market.

The global economy is increasingly presented by economists as a complex self-organizing system that cannot and should not be controlled, much like contemporary ecological representations of nature as a complex self-organizing biophysical system. Links between ecology and economic ideas and theories have been explored by environmental historians such as Donald Worster (1994) who argues that the way ecologists describe nature's economy often reflects developments in the capitalist economy (Worster 1994).

The critique of the command, control and caretaking of biophysical systems that has flowed out of insights from complex systems science shows surprising similarity to neo-liberal critiques of the state with the increasing emphasis on managing (coping with and adapting to) unpredictable self-organizing global markets. In particular, the innovative power of creative destruction and disturbance emphasized by Holling's Figure eight model (*see* footnote 4 on page 60) bears a striking resemblance to Schumpeter's analysis of capitalist business cycles and Friedrich von Hayek (1944) and Milton Freidman's Chicago School critique of Keynesian economics and centralized command economies. The emergence of contemporary forms of natural resource management science, therefore, needs to be understood as occurring within larger socioeconomic and political developments (Peet and Watts 2004).

### 3.7 Crisis and Reinvention of Natural Resource Management Politics

The shift in emphasis from managing natural resource systems to managing human interactions with those systems raises questions surrounding the politics of NRM, especially its connections to centralized state-based administration. An exploration of the politics of NRM illustrates that "control over the resources of others, in the name of planetary health, sustainability, or preventing environmental degradation, is never too far from the surface of many western proposals for global environmental management" (Harvey 1993:25).

Critiques of Newtonian science have resulted in an increased emphasis on systems theory and the ecosystem concept in NRM. While this shift has the potential to direct science away from control-oriented instrumentalism and reductionism, it is also important to recognize that "the ecosystem concept has ambiguous connotations, as both organic and mechanical metaphor with both holistic and reductionist implications" (Hammond 1997:199). Critics of systems theory have tended to focus on its reductionist incarnations, expressing concern over the potential for the concealment of the interests of its proponents in "securing for themselves a privileged role in the management of society" (Hammond 1997:199). Nancy Peluso (1993:216) convincingly argues that:

> Wherever the state directly claims, controls, or manages land-based resources, state organizations and individual state actors have strong vested interests in the commercial exploitation of resources. Their control over the territories within which the resources occur, and over the people living within them, is a major aspect of their strategic territorial controls.

Echoing Peluso's concerns, David Harvey (1993:25) draws attention to the fact that "all ecological projects (and arguments) are simultaneously political-economic projects (and arguments) and vice versa." When exploring the shift from control and careful use to coping rhetoric in natural resource management, it is important therefore to understand the historical role of power, how it operates, and the influence of recent shifts from central state planning to an emphasis on market mechanisms to manage ecologies and economies (Peet and Watts 1996, Jessop 2002, McCarthy and Prudham 2004).

Flowing from a linear view of causation and control, a belief in the certainty of Newtonian science, and reductive assumptions of human nature, forms of power and politics in NRM have traditionally been associated with coercive top-down centralized state practices. The philosophy of Thomas Hobbes is critical in adding legitimacy to this management as coercive state-control approach. The immensely influential *Tragedy of the Commons* thesis, put forward by Garret Hardin (1968) and repeated in many NRM documents since, re-inscribes the assumptions of human nature and management which Thomas Hobbes put forward in the seventeenth century (Stanley 1983, McCay 1994, Sinisi 1994, Ostrom 1999). The *Tragedy of the Commons* thesis places blame for the overexploitation of common pool resources on innate human greed and self-interest, while ignoring the politics of the enclosure movement which required state intervention to destroy embedded forms of commons regulation based on cooperative peasant social relations and largely egalitarian traditions within the peasant class (Torgerson 1990:31).

Hobbes assumed that disorder and violence formed the *natural* condition of all human beings because individuals were asocial free agents (possessive individualists) without ties to community (Hueglin 1999). Given the fear this condition inspired, Hobbes believed that human beings would naturally give themselves over to the authority and power of a sovereign in exchange for the sovereign's ability to create and maintain order (Torgerson 1999). As Douglas Torgerson notes,

> The organizational form contemplated in Hobbes is a rationally constructed artifice of centralized power, an instrument of order exercised through formal patterns of command and obedience. Historically, this is the form adopted in the emergence of the modern state as it arose from diverse, inconsistent patterns of medieval authority. By cutting through traditional bonds and entanglements, the modern state... cleared an orderly, predictable space for increasingly abstract and standardized relationships in state, economy and society (Torgerson 1990:20).

Critics of this Hobbesian tradition in NRM argue that the modern focus on abstract bureaucratic control, as achieved through the visible hands of the state, blinded managers to a diverse set of embedded communal forms of ecological knowledge and regulation tied to a variety of moral economies (Ostrom 1990, Newell and Ommer 1999, Mansfield 2004). This blindness, they argue, resulted in the division, by state-based experts, of common pool resources primarily into state property with embedded forms of knowledge and communal forms of property ownership cast as tragedies waiting to happen (McCay 2000). From this Hobbsian perspective, "local ecological knowledge" and traditional forms of commons regulation have nothing to offer scientific management because the former simply reflects the collective expression of self-maximizing individual behaviour (Stanley 1983, Sinisi 1994).

Operating from this perspective, natural resource management has defined practical and useful knowledge as that which makes nature and society legible to centralized authority (Scott 1998). This has meant that non-quantifiable, traditional or experiential knowledge has not been considered legitimate for natural resource management unless it can be translated into quantified knowledge useful to the scientific practices of the State (Agrawal 2002, Holm 2003, Nadasdy 2003ab). This centralized command, control and caretaking approach to NRM has generally sought to reduce difference, freedom and autonomy by enforcing a rational order amenable to predictability and control (Torgerson 1999). From this perspective, expert professionals with scientific knowledge are the only legitimate natural resource managers. As a result most people and their knowledge have been excluded from natural resource management and the practice of management has been associated with narrow technocratic expertise (Fischer 2000).

### 3.8 The Politics of Participation in Natural Resource Management

In response to this history of expert state-control, participatory natural resource management seeks to inaugurate new forms of managerial practice that move beyond top-down control by extending managerial peer communities and expanding the definition of legitimate knowledge (Ostrom 1990/1999, Funtowicz and Ravetz 1993). Rather than challenging the efficacy or ethics of management itself, this shift towards recognizing local and traditional ecological knowledge implies that a much broader range of activities and knowledge are useful and necessary for effective natural resource management. The collaborative and participatory management models that are offered as alternatives imply a redistribution of "managerial power" (the right to manage) from state to non-state actors. This redistribution of managerial power, however, does not mean that traditional forms of commons regulation run by citizens in local communities are recreated and re-embedded in local experience. Rather, local self-management occurs within a context of the hegemony of scientific knowledge and expanding market relations embedded within uneven power, prestige, property rights, and responsibilities (Fischer 2000, Cooke and Kothari 2002, Holm 2003, Samuel 2004).

Therefore, while there is an increasing recognition that in order for natural resource management to be effective it requires the incorporation of "the experience, knowledge and understandings of various groups of people" (Mitchell 1997:155) this recognition is usually framed as a pragmatic response to the pathologies of state-led command and control where an exclusive focus on narrow expertise and positivist science have not led to biophysical sustainability or equitable distribution. The enormous influence of neo-liberalism and the uneven power relations that exist when non-scientific knowledges are incorporated into science and management often remain unexamined in contemporary NRM scholarship (Holm 2003, Murray *et al.* 2005).

Like the scientific changes detailed earlier, these political changes in NRM occur at a time when central planning and state control of the economy have lost legitimacy and are in retreat in the face of neo-liberal ideology. Critics of the shift from state-based management to more participatory and collaborative approaches argue that these changes must be understood in the larger context of state restructuring and changes in the global capitalist economy. In this context, increasing power and authority from the institutions of the state are transferred to those of the corporate sector resulting in a hollowed out reconfigured role for the state as "facilitator" versus "deliverer" of NRM services (Harvey 1989, Korton 1995, Rose 1999, Cooke and Kothari 2002).

A number of collaborative techniques aimed at including a diversity of actors in developing and implementing natural resource management systems have been proposed[7] (Blumenthal and Jannink 2000). These approaches display varying degrees of power sharing, arguing that all natural resource management activities are embedded within power dynamics involving a broad range of interests that need to be negotiated to achieve consensus (Wallace *et al.* 1996). However, while these techniques are predominantly framed within NRM as pragmatic problem-solving tools to deal with complexity, uncertainty, change and conflict, critics have framed these initiatives as either overt co-optation strategies or politically naïve processes that often result in the strengthening of

[7] These include a broad range of approaches including: the soft systems methodology (Checkland and Scholes 1990), the ecosystem-approach (Kay *et al.* 1999), community-based management (Ostrom 1990) and partnership approaches that involve varying degrees of co-management between governments and local communities (Pinkerton 1999).

powerful economic and political interests through new managerial means (Cooke and Kothari 2002, Hansen and Salskov-Iversen 2002, Holm 2003).

These new techniques deploy entrepreneurial forms of management that emphasize "soft decentered control" and caretaking through narrow versions of the freedom to choose the means to predetermined or unexamined ends, as opposed to the freedom to deliberate on the ends themselves[8] (Arnstein 1969; Rahnema 1993, Cooke and Kothari 2002). Critics of participatory NRM argue that most applications tend to involve passive consultation rather than active citizen control of management processes or deliberation on appropriate human-human and human-environment relations (Arstein 1969, Gray 2002, Holm 2003, Murray *et al.* 2005). The whole idea of managerial relationships, their implicit ontologies and epistemologies as well as their efficacy, political and ethical legitimacy, remains largely unquestioned in these participatory management processes (Parker 2002).

Most proponents of participatory NRM have focused on the problem of coercive top-down forms of state power and surveillance. There has been a relative absence of critical research into newly emerging forms of NRM that seek to promote the active participation of citizens and resource users in processes of NRM implementation (Cooke and Kothari 2002). Advocates of new participatory approaches to NRM often stress the need for a normative-communicative versus instrumentally-rational approach to managerial control, one that works to influence the attitudes, desires and values of political subjects, rather than simply forcing them to follow the rules (Darier 1999, Rose 1999). In combination with widespread criticisms of state-led command and control, these new participatory approaches to NRM significantly undermine the moral authority

[8] Two modes of soft power which are often associated with contemporary participatory management interventions include "the emotional buy-in by citizens and employees; and monitoring and evaluation techniques primarily concerned with efficiency and performance" (Hansen and Salskov-Iversen 2002:16).

of professional managers and civil servants involved with NRM. Across a wide spectrum of professional and managerial fields "experts are no longer automatically allowed…to decide for us—even if they say it is for our own good" (Samuel 2004:8).

However, opening up decision making has not led to a golden age of freedom, democracy and deliberative citizenship in NRM and other fields once the exclusive domain of expert professionals and top-down bureaucrats (Rose 1999, Cooke and Kothari 2002, Samuel 2004). Rather, expert scientific decision making has become universalized and internalized as individual clients of the past morph into consumers and interested stakeholders of the present. As Samuel (2004:9) observes:

> [P]eople are no longer told what to do; they make their own decisions. Yet to make these decisions, they must be taught to think in scientific categories and to use bureaucratic procedures. That is, the decision maker is mature enough to make autonomous decisions but [must]…be trained, like a child, to that task…[using] statistical constructs like risk, economic constructs like utility, accountants' concepts like costs and benefits, scientific constructs such as… target populations, poverty, environment, and so on."

This process of internalized reductionist scientific decision making is not the same as deliberative democratic procedures, nor Samuel (2004) argues, does self-management admit to ways of knowing that do not fit the scientific or bureaucratic mould. With the increasing emphasis on participatory management and decision making "ordinary people are now trained to treat themselves as civil servants and professionals once did. What experts did to you, you now do to yourself" (Samuel 2004:9).

Critics of new participatory management techniques argue that they simply result in formerly dependent clients being "empowered" to believe that their freedom lies in transforming their common sense and practical reason into technical acts that achieve the same oppressive controlling and caretaking relationships through the use of different managerial means and forms of power (Grey 1999, Rose 1999, Cooke and Kothari 2002, Nadasdy 2003ab, Samuel 2004). The knowledge legitimized and privileged in these management processes continues to be dominated by the scientific experts of the top-down coercive past, even if they are now presented as "facilitators" and "enablers" as opposed to top-down experts (Rahnema 1993, Cooke and Kothari 2002, Samuel 2004). Under these conditions, participatory NRM becomes yet another managerial tool that can be used to manufacture consent and maintain a fictional unity and collective problem-solving orientation while co-opting political struggle and moral debate (Cooke and Kothari 2002).

Supporting this critique of participatory NRM is Foucauldian inspired research which argues that managerial power presently operates *through* individual freedom rather than against it, creating self-managing "responsibilized" subjects conditioned primarily through persuasive-normative rather than threatening-coercive or incentive-compensatory forms of power (Darier 1999, Rose 1999, Cooke and Kothari 2002, Hansen and Salskov-Iversen 2002, Dean 2003). Furthermore, critical management scholars argue that as the knowledge, creativity and skill of natural resource users and workers become increasingly important in knowledge-based economies, and as governments become ever more interested in achieving affordable natural resource management, new managerial techniques and forms of power that transcend Taylor's scientific management and Pinchot's centralized bureaucratic conservation rise to prominence. Under these conditions there is an interest in finding new ways to exert influence and control without taking on the level of collective financial, political and ecological risk associated with welfare state management regimes (Peters 1998, Brown 2003, Dean 2003).

With the rise of neo-liberal ideology globally, central planning and top-down state-led bureaucratic management associated with the welfare state have fallen into disregard.

In their place, a focus on downsizing the public sector, the privatization of government services, tax cuts, and downloading responsibilities for management onto individual resource users and the corporate sector has taken hold (Bordieu 1998, Clarke 2001, Ferguson and Gupta 2002, Brown 2003). State-led bureaucratic management with its emphasis on top-down expertise, rational legal frameworks and inflexible proceduralism has been replaced by a new emphasis on flexible, entrepreneurial management emphasizing bottom-up participation by economically interested stakeholders, innovation, public private partnerships and the creation of responsible self-managing individual and corporate "citizens."[9]

Under neo-liberalism, state agencies no longer are seen as being capable or responsible for delivering NRM services alone. Rather, NRM agencies must coordinate and enable industry self-regulation and monitoring, increasingly through new technologies, such as Global Positioning Systems (GPS) tracking "black boxes", poaching snitch lines, and innovative financial incentives tied to the allocation of private property rights disciplined through the market. As McCarthy and Prudham (2004:276) observe, in this neo-liberal climate of market managerialism "collaboration and partnership become the new mantras of regulatory relations between capital and citizen (underpinned by the discursive rebirth of capital *as* citizen), less and less mediated by formal, state institutions." However, while there are moves towards smaller government combined with pressures to conform to a plethora of multinational economic agreements, there is still a heavy reliance on central state agencies to control and coordinate the

[9] As McCarthy and Prudham (2004:276) argue, "neoliberal notions of citizenship and social action are discursively repackaged in the image of homo-economicus, the ideal, entrepreneurial, self-made individual."

delivery of NRM policies in Canada under a framework referred to as the "New Public Management" (Savoie 1995/1999, Davis *forthcoming*).

### 3.9 Power in Natural Resource Management Politics

Fritjof Capra (2002) illustrates the apolitical character that many new forms of NRM based on participation and partnership present. He argues that living systems, such as human organizations, do not need to be forced or coerced to change but rather need only be offered meaningful disturbances to subtly influence desired changes.

> A machine can be controlled; a living system, according to the systemic understanding of life, can only be disturbed. In other words, organizations cannot be controlled through direct interventions, but they can be influenced by giving impulses rather than instructions. To change the conventional style of management requires a shift of perception that is anything but easy, but it also brings great rewards. Working with the processes inherent in living systems means that we do not need to spend a lot of energy to move an organization. There is no need to push, pull or bully it to make it change. Force or energy are not the issue; the issue is meaning. Meaningful disturbances will get the organization's attention and will trigger structural changes... Offering impulses and guiding principles rather than strict instructions evidently amounts to significant changes in power relations, from domination and control to cooperation and partnerships (Capra 2002:112-113).

New forms of natural resource management that emphasize participation and partnerships imply a different modality of management and conception of power. Reflecting neo-liberal management theories, Capra argues that human beings have inherent and universal characteristics which can be triggered if they are disturbed by the right environment. Human meaning is presented as a manageable sub-system by Capra, one that forms the context for individualized choices and decisions. The environment is presented as a malleable space that influences human meaning systems by conditioning human subjects to respond through adaptations to purposely designed, and thereby controlled and carefully used, disturbances. Disturbance and change are given a very narrow instrumental meaning in Capra's arguments and in much of the post-bureaucratic management literature from which he draws and finds inspiration (Senge 1990, Alvesson and Willmott 1992, Rose 1999, Fielding 2001).

Capra, like many advocates of participatory forms of NRM, is enthusiastic about conditioned power, presenting it as a radical break that transcends the power-politics contained in management techniques that deploy coercive command and control or compensatory caretaking[10]. Critics of the new management Capra espouses do not share his enthusiasm for conditioned power through controlled disturbance of the decision environment. Conditioned power conjures images of patronizing propaganda, marketing and advertising that maintain manipulation as their underlying goal—even if they deploy different techniques that work through, rather than against, individual freedom to internalize the management function (Willmott 1993, Rose 1999). In new forms of participatory NRM, individuals and communities are no longer directly manipulated or controlled, instead, attempts are made to engineer the context of their decision making to inculcate the desired response (purchasing a particular product, creating positive attitudes to workplace change, or buying into an ecosystem management plan, for example). This deploys normative control that moves beyond overt force or manipulation[11].

[10] Capra defines conditioned power in the following manner: "In recent years, biologists and ecologists have begun to shift their metaphors from hierarchies to networks and have come to realize that partnership—the tendency to associate, establish links, cooperate, and maintain symbiotic relationships—is one of the hallmarks of life...[T]he shift from domination to partnership corresponds to a shift from *coercive* power, which uses threats of sanctions to assure adherence to orders, and *compensatory* power, which offers financial incentives and rewards, to *conditioned* power, which tries to make instructions meaningful through persuasion and education" (Capra 2002:113-114 *emphasis added*).

[11] Given the etymological link management has to horse training, it is interesting to note that the evolution of horse training techniques from the 16th century to the present resonate with recent changes in NRM and post-bureaucratic management theories and practices. Where once horses were coercively "broken-in" they are increasingly trained using non-violent techniques associated with the "round pen" (Patton 2003). The "round pen" training approach is described as "starting" versus "breaking" young horses and "was devised in explicit opposition to the cruelty of the conventional method" (Patton 2003:85). The round-pen training techniques "naturally" instill discipline indirectly and normatively through controlling the decision environment of the horse and forcing eye contact between the trainer and the horse, establishing relationships of trust versus fear (Patton 2003). These new techniques "reject the idea that training

### 3.10 Property, Institutions, Governance and Natural Resource Management Politics

A reconsideration of property regimes, particularly the assumption that common property is always a tragedy waiting to happen, accompany the new roles for the state, civil society and the private sector implied (or espoused) by emerging forms of natural resource management. An increasing number of historical studies are making it clear that the "commons," assumed to be open access, had a diversity of locally embedded regulatory systems in place, the removal of which required extensive state action (Durrenberger and King 2000). It is the desire to replace these embedded property regimes with newly created arrangements between the state, civil society and the private sector that motivates much of the collaborative and participatory NRM literature (Mansfield 2004).

However, new collaborative natural resource management initiatives seek to design and re-program common *property* relations in the context of rampant erosion of numerous *commons* worldwide (Mansfield 2004). As Mansfield (2004) argues with respect to fisheries, many proponents of collaborative NRM claim that it is open access to property rather than common property regimes that lead to the overexploitation of natural resources. By making property the central focus of their analysis, however, collaborative and participatory natural resource management scholars run the risk of endorsing "the neoliberal argument that property rights can harness people's supposedly innate profit motives for the good of all" (Mansfield 2004:315). Rather than problematizing the antagonistic relationships that exist between commons, common property and private

proceeds by domination or coercion in favour of seeing it as a form of dialogue or negotiation" much like the way new participatory management techniques are presented as transcending politics, conflict and coercive power in the strive to achieve win-win solutions (Patton 2003:88).

property; these different forms of eco-social relationship are most often presented as potential partners that can coexist for mutual gain in the "new conservation" (Singh and van Houtum 2004).

"New conservation" and natural resource management initiatives jettison the "state is best" model and sanction a new truth that "local society plus market is best." (Singh and van Houtum 2004:260) Advocates of this new approach claim that natural resource management should move from being state-centered to being more based in society, especially at the local level (usually conceptualized as the "community"); that the twin goals of economic growth and sustainable use can be achieved through technical innovations; and that "unfettered markets give individuals the greatest freedom in choosing what to produce and consume, and that patterns of natural resource use are best determined by market processes" (Singh and van Houtum 2004:256).

The "new conservation" and natural resource management increasingly judge the success of management by examining the economic costs it accrues to the state. For example, in Newfoundland, fisheries management costs range from 15-25% of the gross value of fish landings (Arnason *et al.* 2000). This finding leads economists to ask questions about the "economic efficiency of management" (Arnason *et al.* 2000). Moves towards more collaborative, participatory forms of management can therefore be understood as part of state restructuring projects, the neoliberal focus on balanced budgets and an increasing emphasis on auditing, continuous efficiency gains, and doing more with less. This logic leads managers to ask: can NRM expenditures "be justified in the sense that the benefits exceed the costs?" (Arnason *et al.* 2000).

Pressure to cut costs and download responsibilities for NRM onto natural resource users has created a renewed emphasis on co-management as well. However, Elinor Ostrom (1999), an advocate of co-management and community-based NRM, has identified the importance of clear boundaries, predictability, and the presence of indicators of resource quality for effective co-management between local resource users, states and markets. As Blumenthal and Jannink (2000:4) note "where natural resources are less easily understood, ways of simplifying those resources are necessary if collaborators are to reach a common understanding of the resource and options for its management." While a reduction of the scale of management to the local level may lead to the establishment of these conditions, these simplifying conditions are the very ones which ecosystem science warns against. Pockets of clear boundaries, predictability and the presence of indicators of resource quality may be extremely difficult to establish. This is especially true in overlapping eco-social systems spanning a variety of spatial and temporal scales and those embedded in global markets and trans-boundary species migrations which constitute many of the most pressing NRM problems.

Problems of this sort have resulted in calls for nested multi-scalar natural resource management to permit learning and feedback across different spatial and temporal scales (Folke *et al.* 2000). Again, this multi-scalar management requires the recognition of a multiplicity of management actors and new forms of organization that both include and transcend the institutions of the state and the instrumentally rational control techniques associated with bureaucratic power and management. With new collaborative forms of NRM and their normative approach to control and steering,

> Citizens are called on to come together across disciplinary, management, and ownership boundaries to collectively determine management goals, development management plans, implement those plans, and monitor and adjust as necessary. To do so they must embrace a

> new form of governance, based in direct, or participatory, democratic theory (Cortner and Moote 1999:91).

Cortner and Moote's use of the word "governance" to describe natural resource management marks a central shift in NRM toward multi-level management that includes the state but adds additional actors into broad heterogeneous management networks.

Critical assessments of the rise of governance contest Cortner and Moote's belief that governance necessarily relies on or inevitably increases participatory democracy (Walters 2004). Walters (2004), in a recent critical review of the governance literature, criticizes governance and the new management it represents for its anti-political technocratic problem-solving orientation. Walters (2004) and other critical observers of governance discourse (Dean and Hindness 1998, Ferguson and Gupta 2002, Jessop 2002) note that while governance claims to move beyond a singular focus on oppressive state-focused management to embrace inclusive collective problem-solving processes involving a host of "communities", "partners" and "stakeholders" it "is not really about the expansion of democracy but the search for more effective and efficient forms of problem management" (Walters 2004:34). Other political perspectives such as eco-Marxism (Foster 2000), deep ecology (Sessions 1995), social ecology (Bookchin 1994), ecofeminism (Merchant 1996), and political ecology (Peet and Watts 2004) emphasize the fundamental antagonisms inherent in society-nature interaction. These perspectives highlight struggle, contestation, and social transformation. However, governance and new discourses of participatory NRM often display a fundamental liberal bias that emphasizes norms of consensus and mutual accommodation in processes aimed at problem solving within the material and structural status quo (Walters 2004). This provides an extremely instrumental vision of democracy that, by erasing political struggle, "functions as little more than an institutional support for market-oriented reforms" conducive to private economic action (Walters 2004:34).

> Where many political discourses seek to articulate a field of antagonistic forces as agents of political transformation, governance seeks to implicate them as partners in a game of collective self-management and modulated social adjustment. Governance does not deny that societies contain groups with different interests and conflicting agendas but it does not see these differences as a threat to the social order. On the contrary, governance is about harnessing these different inputs and engaging the plurality of stakeholders and partners in an ongoing process of problem solving through "mutual confrontation" a confrontation that can be functional to the advancement of society" (Walters 2004:35).

This transformation of politics into problem solving can only occur under political and historical conditions where social conflicts no longer threaten social order, "where instead of threatening social order, social conflicts can now be harnessed to serve political ends" (Walters 2004:36). Arguments such as Walters (2004) point to the fact that the knowledge of natural resource users and other stakeholders in new participatory and collaborative forms of NRM is often only considered legitimate if users and stakeholders agree to become "responsible partners" within narrow managerial processes, otherwise they run the risk of being criminalized and framed as "poachers" or other illegal non-participants. In this way governance and new participatory NRM processes can serve to deny that natural resource users and other human and non-human stakeholders have interests that are "fundamentally incompatible or antagonistic to the present order of power, that their [past] 'exclusion' is a structural effect rather than a remediable anomaly, or that [their] inclusion would imply a fundamental reordering" of the current eco-social system (Walters 2004:36).

Participatory NRM is extremely seductive since it deploys language emphasizing adaptation and coping over coercion and control, order over chaos, unified and capable communities over conflicting interests, responsibility and civility versus irresponsible individual self-interest, and trust versus antagonism and power politics (Walters 2004). However, in this process, "Questions of political conflict are obviated, displaced, or sublimated by an appeal to universal values and virtues, and the need to cultivate the mechanisms and institutions which promote them" (Walters 2004:37). As a result, the control and caretaking emphasis in NRM can easily be relocated and obscured in favour of a collectivist, depoliticized language of coping and adaptation to biophysical and economic systems that are taken as naturally given and beyond reproach.

The implication of these shifts from exclusive state-based, expert-led natural resource management to collaborative and participatory approaches is that a much broader range of activities and knowledge come to be considered as managerially relevant and a much broader range of actors are framed as potential "managers" (Grey 1999). The ultimate aim of these approaches is to move towards local self-management through an increasing reliance on heterarchical governance networks that require participatory "buy-in", as opposed to hierarchical management directed exclusively by experts in centralized state bureaucracies working in the name of the common good. However, since these changes are occurring in a context of massive power imbalances and inequality in managerial means—between actors situated in the state, civil society and the private sector, not to mention species other than humans situated in their own contexts—the actual outcomes of participatory natural resource management and the erosion and re-articulation of the role of the state are ambiguous and continue to be politically contested. It is not at all clear that these new approaches result in solutions to the twin crises of nature and justice.

## 3.11 The Underlying Human-Nature Ethic and Paradigm of Natural Resource Management

Management as control, careful use and coping operates from the utilitarian assumption that nature is a law-bound standing reserve to be instrumentally exploited by human beings (Heidegger 1977). From this understanding, nature is a separate "thing" that is to be accorded no intrinsic value, only instrumental value with reference to human use. Nature is treated solely as a means to human ends and is described as a collection of resources, natural capital, or ecosystem services and processes. This approach to the world is labelled as anthropocentric by environmental ethicists (Evernden 1985, Oelschlaeger 1991).

From the perspective of anthropocentrism reality is made up of only two classes of "things": nature and not-nature (i.e. human beings). Natural things are accorded instrumental value, which means their value can be calculated; it can be seen as merely a means to an end. Humans are accorded intrinsic value, which means they are seen as ends in themselves worthy of moral consideration, respect and autonomy. Given the dualism embedded in Western environmental thought, there are two choices when responding critically to this anthropocentric NRM. One is to claim that nature is "like us" and therefore should be accorded person status. The other is to argue that we are like nature, that human beings are objects which operate according to natural laws and should therefore be treated as "resources" and "systems" (Evernden 1993). The central question becomes: "Is nature more human, or is the human more natural?" (Evernden 1993:102). Both responses are evident in the shifting rhetoric within natural resource management from control and caretaking to coping.

One of the most widely cited environmental ethics in natural resource management is Aldo Leopold's famous "land ethic"—"a thing is right when it tends to preserve the integrity, beauty and stability of the land community, it is wrong when it tends otherwise" (Leopold 1949). Leopold advocates an ecocentric extensionist ethic, where the moral boundaries of personhood expand to include "not only other peoples but also other species and even the land itself" (Evernden 1993:100) (*For a description of various environmental ethics see* Table 3.3). In opposition to management and managers, Leopold advocates that human beings become plain members and citizens of the land community (Leopold 1949:204).

**Table 3.3** Environmental Ethics (Adapted from Merchant 1992:68-69).

| | *Egocentric (Individual) 17/18th C.* | *Homocentric (Society) 19th C.* | *Ecocentric (Ecosystem) 20th C.* |
|---|---|---|---|
| **Human/ Nature Paradigm** | Domination *Over* Nature (Genesis I) – Individual stewardship of soul to achieve individual salvation | Management *Of* Nature (Genesis II, Stewardship by humans as God's caretakers)—Golden Rule | Partnership *With* Nature (Plain members and citizens with creation rather than masters or managers)—Human and non-human well being |
| **Focus** | Individual | Society | Ecosystem |
| **Value** | Self-interest—Instrumental Value | Utilitarian—Humans have Intrinsic Value | Existence Values—All living and non-living things have Intrinsic Value |
| **What is good?** | Maximization of individual self interest: What is good for each individual will benefit society as a whole | Greatest good for the greatest number of people | An action is good when it tends to preserve the integrity, beauty, and stability of the biotic community—Leopold |
| **Goal** | Individual Freedom | Social Justice | Eco-Justice |
| **Influential Ideas** | Hobbes/Hardin | Pinchot | Leopold |
| **Approach and Process to Achieve Order** | Mutual coercion, mutually agreed upon | Duties to other humans | Duties to society and other complex, self-organizing systems |
| **Approaches toward Nature/Society/ Individual** | Control | Caretaking | Coping & Maintenance of Capacities for Self-Organization |
| **Science** | Normal/ Mechanistic | Normal/ Mechanistic and Holistic | Post-Normal/ Holistic |
| **"Natural" Economic System** | Laissez Faire Capitalism | Welfare State Capitalism | Ecological Economics |
| **"Natural" Identity** | Consumers | Clients | Citizens |
| **"Natural" Structure** | Market | State | Community |
| **"Natural" Activity** | Competition | Co-operation | Co-evolution |

On first inspection, Leopold's words seem to point away from management as an identity; no longer masters or managers, humans become one member and citizen among many. What becomes increasingly clear, however, is that many of the terms in the land ethic are contextual and hard to pin down. What is Integrity? Beauty? And Stability? Each of these things is highly observer-dependent and qualitative in nature requiring a sense of proportionality and right or proper fit (Kay and Schneider 1994, Sandilands 1999, Merchant 2005). In addition, if humans are to become just one member among many others in the land community, how are humans to know what the other species want? How are other species to be represented as citizens of the land community? Deep ecologists have proposed various methods of self-extension to include non-humans in decision making processes (Merchant 1992). However, "the idea of extending an ethical system presupposes the existence of creatures that can participate in such a system, and it is here that problems arise. Animals cannot even be consulted about ethical guidelines, much less [be expected to] adhere to them" (Evernden 1993:100).

Perhaps it is the impossibility of ultimately knowing what nature is and what it wants that has led an increasing number of resource and environmental managers to shift their attention from controlling nature to controlling human behaviour. As described earlier, ecosystems are increasingly not seen as things which human beings manage; rather, natural resource management is involved with managing human interaction with ecosystems (Knight 1996, Grumbine 1997, Mitchell 1997). This shift in emphasis addresses complaints of the arrogance of humanism built into management as control (Stanley 1995) by shifting control from nature to the human sphere, but it effectively frames human-human interactions in highly instrumental terms which reduce human beings and their activities to essentialized natural objects amenable to manipulation. The rhetorical shift from management as controlling and carefully using nature to management as controlling and stewarding human behaviour through normative forms of (self)control raises ethical and political questions about how this human management will take place, the difference between citizenship, decision making and self-management, and if it is ethically justified to treat human beings in such instrumentalist terms even if the instrumentalism is self-inflicted. It also points to the shift from collective state-led management to an individualized market-led orientation in natural resource management.

While adaptive, collaborative and ecosystem-based management address fundamental problems with the underlying science, politics, and ethics of management-as-control and caretaking, contradictory and ambiguous assertions have been identified in these shifts to natural resource management-as-coping (Bavington 2002). The recognition of complexity in natural systems has led adaptive managers to advocate the management of human activities, while strategies to address expensive and historically oppressive statist natural resource management advocate increased responsibility, autonomy and self-management by local communities within the dominant neoliberal logic of "market knows best" managerialism. Furthermore, scholars in participatory management argue that some simplification of complex natural resource formations is required to reach consensus on how the management of nature by local communities is to proceed. The desire to switch control from natural to social systems on the one hand, with a concomitant desire to rescale control of natural systems from states to local communities and markets on the other, reveals the problem of dualism at the heart of managerial ecology. In the end, either human beings or nature are treated instrumentally and targeted as a “problem” to be controlled and carefully used through a variety of managerial techniques and institutional arrangements.

When examined through the lens of management, any solution to the crisis of nature (biophysical sustainability) seems unable to also address the crisis of justice (equitable distribution of resources and power), and vice versa. On the one hand, any move to control and carefully use human activity in the name of biophysical sustainability requires treating humans as means rather than ends. On the other hand, moves to redistribute power and authority over resources requires nature to be treated instrumentally, as a means. This unresolvable tension at the heart of managerial approaches to eco-social problems suggests the need to better understand how managerial ecology has played itself out in specific contexts and what alternatives to management might exist in particular times and places. The remainder of the dissertation addresses this challenge through an exploration of the Newfoundland and Labrador cod fisheries.

# CHAPTER 4

## The Birth and Development of Cod Fisheries Management in Newfoundland and Labrador

Why, when and how did management enter the cod fishery in Newfoundland and Labrador and what was the history of the fisheries management that ultimately led to the endangerment of *Gadus morhua*, the largest single layoff in Canadian history and the end of a way of life? This chapter argues that cod fisheries management emerged slowly over a one hundred year period in response to the industrial modernization of fishing at the end of the nineteenth century. The chapter begins with an exploration of the changes brought on by the shift from a mercantile to market economy in Newfoundland and Labrador when diverse fishing interests problematized fluctuations in cod landings. The slow construction of a manageable cod fishery in response to these interests is then presented including a description of the importance of the population concept and the development of bioeconomic models that related fishing mortality to the overall cod biomass available for exploitation. The chapter concludes by discussing the tragic failure of cod fisheries management in 1992 and the shift away from population dynamics models towards ecosystem-based fisheries management.

### 4.1 The Need to Control Fluctuations in Cod Landings

> The process of modernization in the fisheries is both crucial and precarious. It is crucial because stabilization and rationalization are unavoidable if the resources of the oceans shall be accessible as a source of value within modern society. Given the inherent variability and uncertainty of the fisheries, it is also precarious. Modernization is identified with rationalization and control, and to that extent fishing seems almost by definition to be outside its scope (Apostle *et al.* 1998:8).

While cod landings in Newfoundland had fluctuated for centuries with years of lean and plenty, by the latter part of the 19th century urgent attention was focused on controlling these fluctuations to permit profitable industrial exploitation. Rather than being understood as the providence of God—as natural cycles requiring adaptation and non-managerial coping on the part of resilient fishing communities—fishery fluctuations in the second half of the 19th century became an urgent problem for governments.

> By the 1800s many of the natural and unnatural hazards were greatly reduced in the northern Atlantic Ocean as well as in other areas, and increasing numbers of fishermen were competing for the fish. Fishing vessels using steam power and more efficient fishing gear were developed, opening up greater economic opportunities for the fishermen and importantly expanding the fish-processing industry. Investors became interested in fishing fleets, banks were encouraged to lend money, and profits were expected. Because of this expectation of profits, the causes of fluctuations in the catches became of increasing interest, not only to the fishermen but also to the investors and bankers, and hence to the politicians (Smith 1994:10).

Turning fluctuations in fish landings into a problem to be solved by governments was a unique phenomenon associated with modernization. Stabilization and rationalization of ocean resources was necessary if they were to become sources of value in a modern economy (Apostle *et al.* 1998). However, fluctuations in the fishery had historically been accepted as something that was beyond human control and attempts to actively intervene to stabilize and rationalize cod landings had not been pursued by governments.

Biophysical and market fluctuations had always plagued the cod fishery in Newfoundland and continue to do so. Fishing is one of the most dangerous occupations in Canada with injuries and lives lost to unpredictable weather and accidents at sea. Cod fishers hunt a fickle wild species embedded in a capricious sea that poses many threats and challenges to personal safety, family livelihood, and community survival. Before the advent of fisheries management, fishing households devised ways of living that allowed them to cope with natural fluctuations associated with cod and market fluctuations in the price of fish. Occupational pluralism, a variety of subsistence activities, and a combined reliance on the formal and informal economy helped rural Newfoundland fishing communities cope with the inexplicable fluctuations of wild cod, dangerous weather conditions, and uncertain fish markets. As Ommer (2002:34) explains,

> In pre-confederation Newfoundland, the outport economy was based on the fishery and was made up of two subsystems: the formal and the informal. The formal economy operated (through merchants) on an international scale and involved the *exploitation* of fish for export, including incremental technological changes to ensure a steady supply of product for external markets as local stocks came under pressure. The informal economy was local in nature, involved the *utilization* of fish and other resources (berries, wood, vegetables) by people for subsistence. The merchant store was the interface between these two subsystems, the translation point between a cash export economy and a non-cash subsistence way of life, for which the merchant provided necessary inputs, on credit, against fish and other local produce...In effect, the informal economy subsidized the formal one, making fish production economic for the merchant at low labour costs, while the highly structured codfish export-based formal economy supported the more flexible informal one through the equivalent of cash start-up capital for a complex system of occupational pluralism that could weather resource scarcities (including over-exploitation of stocks), international price fluctuations, and other shocks to the formal system.

In the last half of the 19th century, Newfoundland slowly began to modernize. Outport poverty swelled, the number of fishers grew and opportunities in the formal economy began to expand. Colonial, and later national and provincial governments, found themselves under increasing pressure to find ways to control fluctuations in fish landings to ensure the steady exploitation of codfish for international markets and those who stood to profit from them. At the turn of the century, predictable and steady fish landings became a concern, not only for fishers but also investors, bankers and politicians as the pre-industrial mercantile economic system slowly transformed into a modern industrial market economy (Polanyi 1957, Ommer 1994, 2002).

In the decades following Confederation with Canada in 1949, Newfoundland's embedded merchant economy and outport society (formerly dependent on occupational pluralism and the seasonal inshore cod fishery) rapidly transformed under the modern development vision of premier Joseph Smallwood (Wright 2001) [1]. Instead of credit at the merchant store, cash was increasingly paid directly to fishermen for their catch, wage labour in fish plants replaced unpaid household production, financial support from the Federal government through unemployment insurance and other social welfare programs injected money into outports, and the emphasis on a seasonal inshore cod fishery began to be replaced by enthusiasm for a modernized all-season fishery on the offshore banks.

The end of the nineteenth century saw the beginning of an industrial development program that presented the inshore fishery as part of a backward, inefficient part of Newfoundland's past that needed to be left behind (Wright 2001, Ommer 1994, 2002). The promotion of this industrial development program greatly accelerated after the Second World War when a series of unprecedented transformations in the cod fishery occurred. These transformations affected the central organizational unit in the fishery, the scale of capital investments, the dominant commodity form that cod took, and the rate at which cod were killed. Factories replaced families as the major organizational unit in fishing and processing. Year-round waged, as opposed to seasonal and familial, labour on fishing vessels and in fish plants also became commonplace to meet the requirements of industrial production that "required a consistent supply of fish, which could not be provided by Newfoundland's inshore fishers, who, … took almost all their catch from June to October" when cod migrated inshore and seasonal weather patterns permitted access to adjacent fishing grounds (Sinclair 1988:159). The scale of capital investments in the offshore industrial fishing fleet exceeded that of "the total value of inshore fishing craft, gear and shore installations" by 1964 and continued to exceed inshore capital

[1] "After confederation, transfer payments [from the Federal government] effectively replaced the old merchant credit system, injecting cash—which was and still is used as start-up capital for the informal system—into the outports" (Ommer 2002:35).

investments thereafter (Sinclair 1988:159). The production of frozen fish "more than quadrupled between 1950 and 1969, and freezing plants spread to all regions of the island" shifting the dominant export commodity from dried-salted cod to frozen cod blocks (Sinclair 1988:159). Annual cod catches that had fluctuated from less than 100,000 tonnes to a maximum of 300,000 tonnes up to the 1940's expanded to a historic high referred to as the "killer spike" in 1968 when over 800,000 tonnes of cod were captured (Steele *et al.* 1992). Hutchings and Myers (1995) locate this qualitative shift in the scale and efficiency of cod killing with the introduction of technologically advanced factory freezer stern trawlers after WWII. These fishing vessels were first used to catch cod off Newfoundland by the British in 1954, the Soviets in 1956, the West Germans in 1957 and numerous other nations thereafter, leading to an almost tripling of reported cod landings over the short twelve year period from 1956-1968 when maximum historic landings were reached (Hutchings and Myers 1995).

In the 20th century, the modernization of the fishery was complemented by a number of land-based industrial projects such as a railroad, mines, pulp and paper plants, hydro-electric projects and an oil refinery. The modern development vision was perhaps most clearly expressed in the outport relocation program in 1965 that eliminated over 250 isolated fishing communities; offering the inhabitants monetary and service incentives to abandon their isolated outports and move to a number of industrial "growth centers" (Wright 2001, Ommer 2002)[2]. Concentration of the dispersed outport communities was

[2] "The Newfoundland Resettlement Program and its precursor, the Newfoundland Centralization Program, constitute one of the largest government-initiated mass population movements in Canadian history. These programs brought about the disappearance of at least 250 communities, containing in all 30,000-40,000 persons. That represented about one quarter of all communities, and one-tenth of the total population of Newfoundland" (Matthews 1986:1). Newfoundland's outport relocation program fits many of the attributes of "high modernism" discussed by James Scott (1998) in *Seeing Like a State* where national governments sought to order nature and culture in ways that made them legible to centralist states who

deemed necessary so the state could industrialize the fishery and provide modern services to rural Newfoundlanders such as education and health care. The relocation program, like many other modern state projects aimed at civilizing and improving the human condition, "took exceptionally complex, illegible, and local social practices...and created a standard grid whereby [they]...could be centrally recorded and monitored" (Scott 1998:2). Rather than remaining at the mercy of nature, industrial modernization promised a radical reorganization and simplification of cod to fit the species into progressive human plans and modern development goals. The solution to the complexity and uncertainty of the inshore fishery, and a way of life based on adapting to and coping with the precarious behaviour of codfish, was to leave it behind (Wright 2001).

Modern industrial development required a transformation of Newfoundland's economy, ecology, and society resulting in fundamental changes to the way codfish and fisherpersons were conceptualized and how fishing was conducted. Cod, fishers and fishing had to become manageable—controllable and amenable to careful rationalized use—for the government to realize its development goals. Knowledge of cod had to change if an ecosocial order amenable to industrial modernity was to successfully supplant the cashless merchant-subsistence order. Cod had to become a predictable and controlled scientific object—on hand and available, year-round, to provide a stable uniform stream of raw material to fuel export oriented industrial fish plants. Cod had to cease being a fickle wild fish subject to unpredictable annual fluctuations to which fishers had no choice but passive adaptation. The number of people fishing had to decline and those that remained had to adopt new fishing gear and change their identity from semi-

---

could establish "centers of calculation" (Latour 1987) to command and control from capital cities such as St. John's and Ottawa.

subsistence peasants to industrial wage-earners, owner-operator entrepreneurs, and active participants in a growing consumer society[3].

In order to progress and achieve modernization, Newfoundland fishing people were encouraged to grow up and become civilized—to cut ties to their backward, passive reliance on hunting seasonally migrating cod and leave behind their life of subsistence and dependence on merchant credit (Wright 2001). Modernity promised a cash economy free from merchant control, a flood of new consumer goods, and fishing technology that would transform passive cod hunting into active cod harvesting in all seasons and under all weather conditions (Wright 2001). Once cod fishing was modernized, nature and the merchant class would no longer be able to dictate fishing culture—cod and the fishers who hunted them would be consciously remade, rationally steered and stewarded into a market-based ecosocial order and way of life (Wright 2001). The path to achieve this modern, manageable cod fishery was difficult and challenging, and it first required changing the long held belief that cod were inexhaustible.

[3] As Ommer (2002:35) explains, modernization of the cod fishery lowered the number of fishers needed because "technological change…raised [fishing] effort while decreasing labour inputs into an increasingly wage-based economy" (Ommer 2002:35). Part of the way that fishing people were steered away from the merchant-subsistence economy towards the cash economy was through the arrival of American bases in Newfoundland during WWII. The Americans required wage labourers to construct and maintain their military bases and they recruited Newfoundland fishermen to work for cash on the bases. Many of the base commanders reported "poor work habits" of the fishermen who would often leave the bases unannounced when they had raised enough cash for their immediate needs or when the fishery would commence in the Spring (High 2001). This type of labour activity (undisciplined, sporadic, and temporary) was supplemented by activities in the informal subsistence economy. The existence of a subsistence economy with little opportunity for the consumption of formal market commodities made it difficult, in the beginning, for Americans to recruit reliable, disciplined wage labourers who would honour work contracts (High 2001).

## 4.2 From Unlimited Natural Abundance to Fears of Exhaustion

> Are there any sea fisheries which are exhaustible, and, if so, are the circumstances of the case such that they can be efficiently protected? I believe that it may be affirmed with confidence that, in relation to our present modes of fishing, a number of the most important sea fisheries, such as the cod fishery, the herring fishery, and the mackerel fishery, are inexhaustible. And I base this conviction on two grounds, first, that the multitude of these fishes is so inconceivably great that the number we catch is relatively insignificant; and, secondly, that the magnitude of the destructive agencies at work upon them is so prodigious, that the destruction effected by the fisherman cannot sensibly increase the death-rate… nothing we do seriously affects the number of the fish. And any attempt to regulate these fisheries seems consequently, from the nature of the case, to be useless (Huxley 1883:6-7).

While the natural abundance of codfish was not a concern for John Cabot, who reported codfish so thick they reportedly slowed the movement of his ship on the Grand Banks, the political and economic uncertainties associated with getting to the fishing grounds and returning without succumbing to unknown waters, storms and piracy were a major concern for Britain after the "discovery" of Newfoundland. Advances in navigation, boat building, military engagement, War and treaties helped to tame the uncertainty associated with accessing the cod fishing grounds; however, by the late nineteenth century access uncertainty was replaced by new concerns.

Modern industrialization in Europe and the progressive era in the United States created political and economic pressures to maximize the exploitation of the cod resource and change how fishing was conducted in the last half of the 19th century. Modern fishing methods, mechanization and the industrialization of processing focused on increasing production and efficiency in the fishery and it required a steady, stable supply of codfish unencumbered by the vagaries of the natural environment, migrating cod, and the subsequent fluctuations in fish landings. In addition, while the dominant scientific and expert consensus up to the end of the 19th century echoed Huxley's (1883) belief (quoted above) that marine fish were inexhaustible, experiences in Newfoundland and

Labrador and other fishing communities in Europe and North American suggested otherwise (Hutchings *et al.* 2002).

While the influential T.H. Huxley and other fishery experts have become infamous for their belief in unlimited fish abundance relative to fishing impacts, Grant Head (1976) and other Newfoundland fishery commentators (Innis 1954, Cadigan 1999ab, Hutchings *et al.* 2002) have noted that fishers and merchants were concerned about cod exhaustion as early as the 18th century. Cod became increasingly scarce in Newfoundland in the 19th century, and by the last half of the century international debates erupted over the cause of fluctuations in fish landings and the potential for fishery exhaustions. The cod fishery fluctuated wildly in Newfoundland from 1815 to 1836 when landings declined as cod became scarce in inshore waters (Cadigan 1995, Hutchings and Myers 1995). This led many fishers to adopt new fishing technologies (jiggers, seines and long line trawls) and to spatially shift their fishing effort onto less exploited grounds in Labrador and seasonally fished offshore grounds (Cadigan and Hutchings 2001, Ommer 2002, Bavington *et al.* 2004).

These technological and spatial responses to the decrease in cod abundance, however, were reluctantly adopted and in some cases actively resisted by many fisher people in the latter half of the nineteenth century (Cadigan 1999ab, 2003). The scarcity of fish relative to merchant-demand led to heated debates on what to do about the fluctuations and the possibility that cod abundance may become permanently exhausted (Cadigan 1999ab). Inshore fishers and some merchants complained to colonial administrators and government officials that new fishing technologies, such as cod seines, long-lines and jiggers, were a threat to the moral economic order and fishing way of life (Cadigan 2003)[4]. These new fishing gears, it was argued, killed and injured both juvenile and "mother" codfish encouraging viceful fishing practices that resulted in wasteful harm to the fish and growing inequality between fishers using the new fishing technologies and those who could only afford the traditional baited hand line gear (Government of Newfoundland 1849, Innis 1954, Cadigan 1999ab). Ongoing declines in landings, and fluctuating catches in the 1850s "forced the temporary withdrawal of credit by merchants" resulting in extreme poverty and social instability in the outports, creating pressure on the Newfoundland government to actively intervene in the fishery (Ommer 2002:25). The government responded by establishing a fisheries inquiry that proposed laws regarding the size and use of herring seines (herring were used as bait in longline cod trawls), "and…an omnibus act to protect the fish—the Rorke Bill of 1863, which was dropped the following year out of fear of falling exports" (Ommer 2002:26). By 1889 a Fisheries Commission was created by the newly established Responsible Government[5] to respond to the ongoing fishery crisis and regulations were instituted to protect immature and spawning codfish, reflecting the suggestions of fishermen who testified to the commission (Hutchings *et al.* 2002:153)[6]. While the regulations eventually became

---

[4] Cadigan (2003:15) illustrates how "Early nineteenth-century fishers fought to preserve a customary and equitable right of access to fish for all as it became clear that the growing harvesting capacity of the industry threatened the availability of the marine resource for future generations. The preservation of equitable access was an ecological norm of a moral economy that ran counter to the individualistic and accumulative values of a nascent local capitalist political economy."

[5] Newfoundland was granted democratic "Responsible Government" and political independence from Britain in 1888 and was an independent commonwealth Nation until 1934 when the Newfoundland government requested the United Kingdom to install a "Commission of Government" ruled by unelected appointed commissioners to rescue Newfoundland from social unrest brought on by bankruptcy associated with the debts the nation incurred during World War I and the economic crisis brought on by the Great Depression and ongoing failures in the fishery.

[6] The 1890 regulations established by the Fisheries Commission were quite broad and aimed at protecting spawning "motherfish" and juveniles as indicated by the following quote from the Journal of the House of Assembly, 1890: "No person shall, in the following harbours in Placentia Bay, namely: Paradise Sound, Boat Harbour, and Roger's Harbour, use any bultow [longline trawl], cod-trap, cod-seine or any

statutory law with "legal precedence over local customs… the capacity of government to enforce statutory law was limited [and]…there were persistent violations of the…regulations" (Hutchings *et al.* 2002:154).

Even with the subsequent development of a Fisheries Department, fishery laboratories, scientific research on cod migration, and even the artificial propagation of cod through a hatchery, fisheries regulations up to the late 1940s were "more related to orderly fishing than to conservation or control of total fishing effort and catches" (Vardy and Dunne 2003:108).

> In the half-century or so leading up to Confederation, the primary concerns and activities of the various fisheries administrative bodies involved the control and/or development of production and marketing in the salt fish industry. There were no catch quotas or other conservation-directed measures except for some purely local fishing rules. The main focus centered on the fluctuating and often low, levels of export earnings from the undisciplined marketing of usually poor and inconsistent quality salt fish. Indeed the general intention of government over much of this period (and even into post-Confederation years) was to maximize export earnings from the fishery so that surplus labour could be thereby accommodated. Other fisheries initiatives were undertaken to develop new processing activities (fish freezing), improve the quality of products from other species such as herring and modernize fishing vessels and gears. Regulations were developed over the 1900-49 period to control local cod and salmon fishing through a series of measures that eventually included…rules to conduct random berth draws, minimum mesh sizes for cod traps and cod nets, spacing from previously set gear, and closed areas for specified gears. While some of these regulations had the indirect effect of limiting access on a localized basis, there was no consideration given to limiting the total numbers participating in the overall fishery or to directly limiting catches of any species. Nor were there any attempts to restrict harvesting or processing capacity (Vardy and Dunne 2003:107).

The regulations established by the Fisheries Commission and the first fishery departments were difficult to enforce and ultimately failed to save "outport communities from the constant threat of hunger and poverty" that continued to persist into the early twentieth century (Ommer 2002:26).

Fluctuations and failures in the Newfoundland cod fishery and other marine fisheries around the world became a serious problem for governments at the end of the

---

contrivance, except hook-and-line, for catching codfish, under a penalty of one hundred dollars, and confiscation of such contrivance hereby prohibitied" (JHA 1890 *quoted in* Hutchings *et al.* 2002:154).

19th century. Flux and uncertainty in marine fish landings spurred demands for a new field of fisheries science to produce instrumental knowledge amenable to long term productivity and stability in landings to ensure the maintenance of economic and social order amidst the uncertainty and change brought on by industrial modernization (Smith 1994).

> The fluctuations in …fisheries posed serious economic, social, and hence political problems, and in each fishery early steps were taken to scientifically study the causes of the fluctuations. The many specific explanations involved four general processes—migration, predation, pollution, and overfishing—each of which has been invoked time and again since the turn of the century to explain fluctuations of fisheries around the world (Smith 1994:21).

Early explanations in Newfoundland for fluctuations in the cod fishery involved a plethora of observations and arguments from natural historians, fishers, merchants, citizens, and government leaders, as the cod fishery became a serious matter of concern (Cadigan 1999ab). Despite a spotty historical record with little evidence of the views of women and other unpublished opinions; the arguments, and explanations that were recorded illustrate a diversity of perspectives on the "nature of cod" especially on the question of cod migratory behaviour (*see* Hutchings *et al.* 2002 and Cadigan 1999ab)[7]. The public record in Newfoundland and the United Kingdom included debates about the relative contribution of fishing to overall fish mortality, the number of "races" of cod, the migration patterns of the fish, and the relative importance of pollution and predators, as well as the dangers posed by new technologies such as cod seines, cod traps, jiggers, longlines, and draggers.

While these opinions on cod abundance reflected deep concern and experiential knowledge of fish and fishing, they did not produce a type of knowledge that

---

[7] While there is ample evidence of a rich discussion of this issue in the press and in government reports of the time, the observations are biased toward those of men, since women's perspectives and observations had little means of written expression at the time (Bavington *et al.* 2004).

governments could effectively use to solve urgent economic and political problems associated with landing fluctuations and market instability. As early as the 1860s governments began to fund scientists to study the problem of fisheries fluctuations, to test the wide variety of contradictory explanations that had been developing among scientists, fishermen and their citizens and to deliver practical advice that would help maintain productivity and profitability in fisheries (Smith 1994).

> In 1864 the Norwegian government asked George Ossian Sars, son of the pioneering Norwegian marine biologist Michael Sars, to determine why the cod catches from the Lofoten Islands in northern Norway fluctuated so greatly…A few years later, after several visits to the coastal fisheries, Sars asked for and, to his surprise, was loaned a ship to extend his studies offshore. Within twenty years Norway had established a scientific agency to study fluctuations in its fisheries, and had outfitted it with a ship, laboratories, and a fish hatchery. By the turn of the century many other countries had joined Norway in establishing agencies for the scientific study of their fisheries… (Smith 1994:1).

Throughout the latter half of the 19th century a number of scientists, including the University of Toronto geographer H.Y. Hind in 1876, gave advice on how to respond to the decline of the inshore cod fisheries in Newfoundland and Labrador. Hind, like most other fishery scientists at the time, believed that "the means for reproduction of the cod resources of Labrador and Newfoundland [were] 'inexhaustible' and beyond the power of man to injure" (Hind *quoted in* Hutchings *et al.* 2002:148). Hind advocated extending the spatial extent of the fishery to allow the recovery of inshore cod fishing grounds. Despite a plethora of reports, royal commissions and studies, the rapid development of the scientific study of fishing in the later half of the 19th century resulted in few useful answers to governments (Smith 1994:96). "The rapid development of the scientific study of fishing since … the 1860s had resulted in much science being done, but few answers" (Smith 1994:96). In fact,

> Limitations of scientific knowledge resulted in accounts that…drew heavily on the experiential knowledge of fishers and others directly employed in the fishery. Their observations of differences in size, colour, condition, diet, migration, and the timing and

> location of spawning were, of course, mediated by their fishing activities [and]...were also based upon oral transmission of information between generations (Hutchings *et al.* 2002:142).

Just as rural fishing communities had to be relocated and concentrated to make them comprehendible to the modern state, so too did the vast and diverse experiential knowledge of fishers and wide ranging early scientific work on cod require simplification. Causal laws were necessary if governments were to obtain knowledge of cod that permitted control and rationalized industrial use. In order to advance industrial modernization and rationally develop the cod fishery, governments had to simplify the reasons underlying the cod fishery fluctuations to get a handle on the complexity of wild fish productivity and the impact of fishers' actions on cod abundance. It would take fisheries scientists close to one hundred years from the initial scientific investigations by Sars in the 1860s to develop knowledge and causal models of the cod fishery that would permit fisheries management. The shift from diverse qualitative descriptions and opinions on cod abundance to a quantitative science founded on statistical laws and "population thinking" facilitated an understanding of fisheries fluctuations and the emergence of a fully developed cod fisheries management regime.

### 4.3 Constructing the Manageable Cod: From Typological Species to Statistical Population

> [T]he development of population thinking within fisheries biology...was a wrenching process. It is difficult to imagine after the fact how naturalists actually viewed the organic world prior to this paradigm shift (Sinclair and Solemdal 1988:210).

> [T]o discuss the concept of population...is a difficult task since for most people the term seems today to denote a natural entity, an issue about which neutral statements can be made, an object open to human control and management (Duden 1992:146).

In 1898 the German fisheries biologist Freidrich Heincke published an influential paper that "encouraged biologists to consider the population as the unit of study, rather than the species" (Sinclair and Solemdal 1988:201). Heincke borrowed the population concept from human demography to develop a powerful quantitative methodology to distinguish marine fish populations[8]. This focus on quantitative marine biology was revolutionary in its time and by 1930 population thinking had been accepted by most fisheries biologists, and fisheries research organizations began to apply the population concept to answer questions surrounding fluctuations in marine fish landings (Sinclair and Solemdal 1988 and Smith 1994). Even though the precise boundaries of populations were difficult to determine and measurements were often restricted by political and practical considerations, the switch from qualitative typological species descriptions to quantitative population analysis permitted the emergence of a demographic paradigm in fisheries biology that held out the enticing possibility of predicting future catch levels based on statistical laws (Sinclair and Solemdal 1988:209). While the process was slow and cumbersome, involving a number of fisheries biologists and economists, Heincke's conceptualization of fish as members of statistical populations set the stage for the development of bioeconomic models of the fishery that permitted the emergence of cod fisheries management and what appeared to be a final solution to the problem of fluctuations in marine fisheries.

While variation between individuals of the same fish species had long been observed by natural historians, fishers and other lay observers, there was no consensus on how to interpret the observations and turn them into useful applied knowledge for fishery administrators in governments. Fluctuations in cod landings were blamed *both* on local

[8] In hindsight it is ironic to note that managerially relevant fisheries biology originated by borrowing a methodology from the social sciences at the end of the 19th century. At the end of the 20th century social scientists would complain that their disciplines were not having enough influence on scientific fisheries management (this will be discussed in greater detail in chapter five and six).

overfishing *and* variability in migration patterns leading to contradictions and confusion around the need for, and usefulness of, fisheries management (Smith 1994, Hutchings *et al.* 2002). The dominant scientific theory on fish migration before Heincke—the Dodd-Anderson polar migration theory—was based on the assumption that Atlantic fish species such as cod and herring migrated annually as one vast aggregation to the Northern polar region (Smith 1994, Sinclair and Solemdal 1988). If the polar migration theory was correct, then local declines in landings could be attributed to inter-annual differences in migration patterns rather than local overfishing and efforts to restock local fishing grounds with hatchery raised juveniles (a practice that was being pursued for cod in Newfoundland, the United States and Europe at the end of the nineteenth century) appeared pointless (Hutchings *et al.* 2002). The Swedish biologist Neilson, a predecessor of Heincke, hypothesized that herring did not migrate over large distances (as was suggested by the polar migration theory) but formed numerous spatially bound varieties or "races" that required local regulation of fishing effort to ensure stable fish landings (Sinclair and Solemdal 1988). Neilson, however, was accused of "oversplitting", identifying too many local varieties of herring, and the dispute between "splitters" and the polar migration "lumpers" formed a significant scientific debate that was "fought out not only in the essays of learned societies, notably the Swedish Academy, but also in writings of economic societies, in numerous lectures, and in the daily press" of European and Newfoundland newspapers (Sinclair and Solemdal 1988:192, Cadigan 1999ab, 2003 Hutchings *et al.* 2002).

The conflict and chaos in the literature was fueled by methodological limitations in the identification of local varieties or "populations," and the political implications that seemed to follow the identification of local "races" (Sinclair and Solemdal 1988, Jansen 2000). Different races, varieties and "populations" of fish were identified through qualitative diagnosis of individuals according to typological descriptions and Neilson and his followers advocated local control of fishing for all the populations they identified (Sinclair and Solemdal 1988). Many of the "descriptions of putative populations very quickly turned out to be useless" however, since they could be explained in terms of "differences in age, sex, maturity, and nutritional state, rather than due to population differences" (Sinclair and Solemdal 1988:192). Heincke solved the long-standing debate between the influential polar migration theory and Neilson's local population hypothesis by developing a rudimentary form of multivariate statistics and calculating normal curves following a methodology he borrowed from anthropology.[9]

The use of quantitative methodology was a major accomplishment and detour from the traditional work of natural historians and fisheries biologists who had, according to Heincke, "a pronounced aversion toward measurements and numbers" (Heincke 1898 *quoted in* Sinclair and Solemdal 1988:195). Heincke suggested that this aversion to mathematics had to change if knowledge of nature's laws and the advancement of practical fisheries research were to occur.

> This aversion is admissible when it is a manner of gaining a quick overview about the manifold varieties of organic forms, and is pardonable when the pleasure of the composing artist in the beauty and variety of forms and in his fanciful conceptions is greater than the sense for exploration of the analytical scholar; but this aversion toward measurement and numbers, which at times is heightened into contempt, is

---

[9] Heincke studied herring in an attempt to distinguish different "races" or populations. He made measurements of over 50 characteristics on approximately 8000 individual herring specimens collected from various geographic locations. He developed a rudimentary multivariate statistics to analyze the diverse characteristics from his large sample size and "from the averages and coefficients of variation he calculated Gaussian or Normal curves following methodology that had recently been developing in anthropology. He tested for differences between geographic populations in single characteristics by comparison of distribution curves which differed according to their means, coefficients of variation, or both. Heincke in this manner analyzed a number of characteristics which he showed to be independent of age and gender (number of vertebrae, keel scales, and fin rays)" (Sinclair and Solemdal 1988:194).

> incomprehensible, inadmissible, and unpardonable when the scholar demands that his labours be regarded as a contribution to the knowledge of the true laws of nature (Heincke 1898 *quoted in* Sinclair and Solemdal 1988:195).

Heincke was the first person to apply statistical methods to biological types other than human beings and applying quantification techniques in marine biology led to significant practical advances in knowledge and a quantitative revolution in the field (Sinclair and Solemdal 1988, Jansen 2000). Heincke found that variability in many of the morphological characteristics of the Northeastern Atlantic herring he studied were distributed following normal curves that accordingly obeyed the laws of probability allowing populations to "be identified by the use of single characteristics, and individual membership by his method of least squares of combined characteristics" (Sinclair and Solemdal 1988:195). Heincke's call in 1898 for marine biologists to adopt population thinking and embrace measurement and numbers in their research methodology led to profound changes in fisheries science and its usefulness to governments interested in solving the fluctuating-landings problem. The development and spread of population thinking in fisheries biology from 1880-1930 fundamentally altered how nature was understood and perceived. From the typological species of Linnaeus that emphasized qualitative descriptions of ideal types, a Darwinian view of the world emerged in fisheries biology that placed the emphasis on variability, evolutionary change and the disciplined analytic search for natural laws.

Not until after World War II did a theory amenable to fisheries management emerge, thanks to the contributions of numerous scientists. The symbolic representation of fish as members of statistical populations changed how fish, fishers and fishing were understood. By 1950, fisheries scientists had largely abandoned qualitative description and were concentrated on quantitative measurements and the application of statistical tools, not only to identify but also to explain the dynamics of fish populations exposed to fishing pressure (Smith 1994). Fish populations were eventually represented as self-regulating systems tending toward equilibrium, whose fluctuations were determined by the relationship between reproduction, individual growth rates, natural mortality and fishing mortality (Holm 1996, Wilen 2004) . Building on a number of partial theories on the dynamics of fish populations under exploitation, in 1957 Beverton and Holt published a groundbreaking model that allowed scientists to "predict the future size and yield of fish stocks for different catch regimes on the basis of readily available data" (Holm 1996:180). By assuming that fish populations were reasonably stable over time and that they behaved predictably under moderate levels of exploitation, the Beverton and Holt model permitted the calculation of optimal yields from a fishery (Holm 1996)[10]. By controlling the amount of fish killed due to fishing, Beverton and Holt (1957) argued that fish populations could be made to produce maximum sustainable yields. No longer was fishing, with all its various techniques, to be seen solely in a positive or negative light, in the influential population dynamics models of Beverton and Holt and other fishery scientists, fishing mortality was aggregated and came to be seen as a *variable* which, if controlled and carefully used, would directly influence the productivity of fish populations.

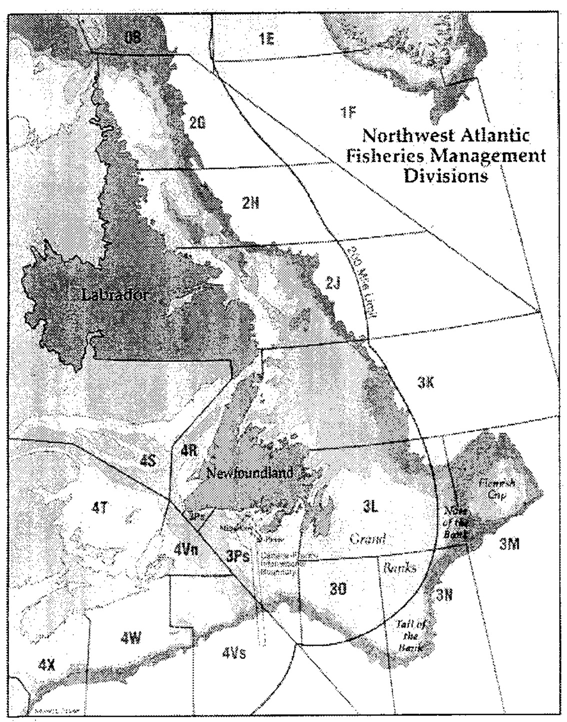
[10] Beverton and Holt stressed the balanced, steady-state tendencies of fish populations in their population dynamics models and described their approach as relating to the general systems thinking of von Bertalanffy (1950) and the mathematical methods of operations research that had developed out of experiences in World War II (Smith 1994). Beverton and Holt (1957:23) noted that, "One essential aspect of this synthesis is the recognition of a fish population or community of populations as a self maintaining *open system*, exchanging materials with the environment and usually tending toward a steady state." Their theory focused on what they termed "self regenerating population models, adapting a term used by radio engineers to describe a system which "feeds back into itself" (Beverton and Holt 1957:63 *quoted in* Smith 1994:326).

The statistical description of fish as aggregated members of reproductively separated populations eventually produced models that allowed governments to believe they could finally control fishery fluctuations and pursue socio-economic development goals associated with industrial modernization. For the first time in history, cod appeared to be manageable objects—statistically determined aggregations of self-sustaining groups of wild fish that persisted in particular geographical areas over ecological time scales, whose productivity could be influenced by carefully using fishing to kill specified numbers of "surplus" fish in separate, identifiable populations (Sinclair and Solemdal 1988:190, Smith 1994, Holm 1996). Rather than relying on the diverse observations of fishers, unenforceable local fishing rules, and the uncertainty of inshore cod migrations, by the 1950s governments were presented with scientific knowledge of cod abundance offshore and quantitative tools to calculate optimal fishing levels that promised to put an end to fluctuating landings and the political and economic problems that accompanied them.

In Newfoundland and Labrador population-based management units for northern cod were established from 1932 to 1978 by the International Commission for the Northwest Atlantic Fisheries (ICNAF) and later the North Atlantic Fisheries Organization (NAFO). Debates around the relative homogeneity of northern cod populations, the scale at which statistical data should be collected and how boundaries should be drawn for fisheries management zones were intense throughout the early history of ICNAF and NAFO. Ultimately, they were determined by pragmatic considerations associated with collecting statistical population data to permit quantitative modeling (Halliday and Pinhorn 1990, Lear and Parsons 1993). Despite the presence of scientific evidence indicating complex inshore and offshore migration routes, stock mixing, and diverse spawning patterns, large scale management zones emphasizing offshore populations became institutionalized (Halliday and Pinhorn 1990).

While several proposals to redraw cod management boundaries to recognize the existence of separate inshore and offshore cod populations were proposed throughout the 1950s and 60s, the expense and difficulty of collecting accurate statistical data in numerous small management zones, as well as the significant modeling benefits of maintaining historically consistent boundaries that permitted inter-annual statistical comparison, led to the maintenance of large scale Northern cod management zones based ultimately as much on lines of latitude as complex stock structures or migration routes (Halliday and Pinhorn 1990, Hutchings *et al.* 2002) (*see* Figure 4.1).

**Figure 4.1** Northwest Atlantic Fisheries Organization (NAFO) fisheries management zones (MUN 2005).



Fisheries management zones for *Gadus morhua* aggregated inshore and offshore populations assuming that all cod followed capelin in the spring from offshore banks to inshore waters and that all spawning took place randomly within the specified management zones on the offshore banks after cod had migrated back from inshore waters in the autumn (Hutchings *et al.* 2002). The above assumptions allowed Northern cod to be conceptually domesticated and grasped, symbolically represented as numbers that could be calculated and manipulated safely in models on land while the actual living cod swam freely in the wild North Atlantic.

## 4.4 Constructing the Manageable Cod Fishery: Domesticating Fish and Fishers as Elements in Bio-Economic Systems

> In addition to the symbolic representation of the fish, fisheries management required a symbolic representation of the fisherman and a model of how the two would interact. While fisheries science developed in response to social and economic problems, fishery biologists have been hesitant to include humans in their models. The completion of the fisheries management model was therefore undertaken with crucial assistance from economists (Holm 1996:181).

Population dynamics models were a powerful invention that promised the possibility of not only controlling fluctuations in landings but optimizing the productivity of cod populations. However, the models required fishers to adjust their fishing activities to come in line with what the models suggested. To achieve maximum catches, the population models proposed what was at the time a counterintuitive notion—that less fishing would lead to greater landings over the long term[11]. While fisheries biologists had identified demographic laws and self-organizing feedback relationships among individual growth, reproduction, natural mortality and fishing mortality rates that

[11] The counterintuitive connection between fishing effort and cod landings was first noticed in Europe when large catches of groundfish species rebounded in the North Sea immediately following the end of the two World Wars. Large catches immediately following the end of conflict, suggested that lowering fishing efforts could produce larger yields (Smith 1994, Holm 1996).

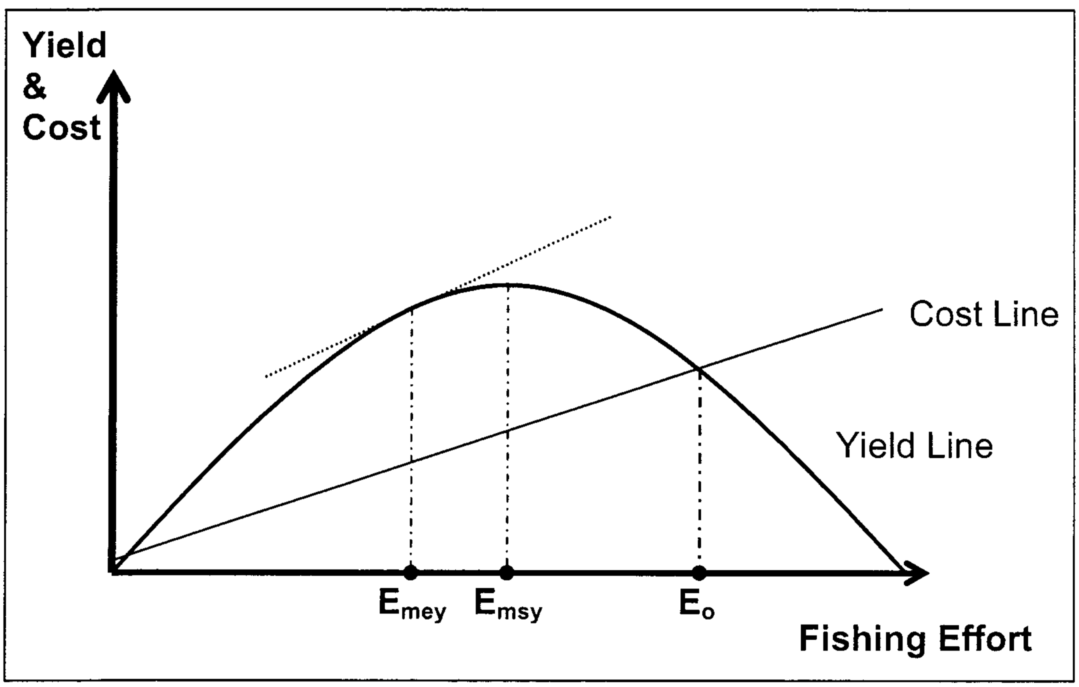
determined cod population sizes over time, there was little scientific understanding of how individual people behaved when they went fishing for cod.

> The major obstacle for management at this time was that [fisheries models]...treated the fisherman as an external factor. This would not have been a problem if the fisherman automatically had followed the scientists' advice reducing their efforts to the level where the yield would be optimal. Such was not the case, however (Holm 1996:180-181).

In the 1950s fisheries biologists began to lament the growing competitive element in the fishing industry which made it "difficult if not impossible for the industries to regulate themselves to obtain a more favorable balance" (Beverton 1952:1 *quoted in* Smith 1994:323). While self-regulating feedbacks between reproduction, growth, and natural mortality had been discovered in fish populations and the impact of various levels of fishing mortality on these variables could be calculated to determine the level of fishing that would result in maximum sustainable yields, the behavior of the humans that imposed fishing mortality on populations had not been theorized. Economists addressed this problem in the early 1950's by arguing that the costs of fishing and the behaviour of fishers could be quantified and dynamically related to the other elements in population models. The Canadian economist H. Scott Gordon (1953) led the way in proposing the integration of fishers' behaviour into biological models arguing that "the large numbers of fishermen permit valid behavioristic generalization of their activities along the lines of the standard economic theory of production" (Gordon 1953:128 *quoted in* Smith 1994:334). By modeling fishers as rational profit-seeking individuals operating with free access to productive fish populations and linearly increasing fixed unit costs for their boats and gear, Gordon developed an influential cybernetic systems model that illustrated how human fishing activity was "behaviourized or determined" by elements in a mutually interdependent bio-economic system (*see* Figure 4.2) (Smith 1994:335). The demographic laws of cod populations had been joined up with economic laws associated with competitive human behaviour.

**Figure 4.2** Adapted Gordon-Schaefer Model (From Holm 1996:181).

This model combines Gordon's assumptions on the behaviour of fishers with Schaefer's population surplus production model. The model illustrates how a fish population will develop under different fishing intensities given the assumption that each effort level results in a stable population size and a stable reproductive output. "Starting from zero, increasing fishing effort produces higher output—up to the $E_{msy}$ point. Beyond that, the stock's ability to reproduce starts to decline, and catches go down. Adding assumptions regarding harvesting costs and the behaviour of fishermen, the model can also predict at which level fishing effort will stabilize. With a linear cost curve, implying fixed unit costs of harvesting, under free access to the fishery and rational profit-seeking fishermen acting independently, effort will increase to $E_0$. At this point, the economic profits are zero, and there is no reason for established fishermen to increase their effort or for new ones to enter. This, however, represents too much effort from almost any point of view, since it wastes both protein and profits. From a food supply perspective, the harvest should be at $E_{msy}$, the point maximizing the sustainable yield. From an economic point of view, the harvest should be at $E_{mey}$, the point maximizing the resource rent. To get to either of these points, the parameters of the model—and the fishery—have to be changed" (Holm 1996:180-181).




Gordon's bio-economic model revealed the need for fundamental changes in how fishing was organized and conducted. He argued that the management goal of maximum sustainable yield ($E_{msy}$), promoted by fisheries biologists, was economically irrational because it did not take into account the costs of fishing nor the need for reasonable profits for those engaged in hunting fish (Gordon 1953). Gordon's model also argued that fishing effort would eventually regulate itself as rational profit-seeking fishers realized that the cost of removing fish from sparse populations exceeded the profits they were able to obtain (*see* Figure 4.2—$E_o$). Gordon argued, however, that both $E_{msy}$ and $E_o$ were suboptimal and he promoted the idea of maximum economic yield ($E_{mey}$), arguing that the fishery should be controlled and carefully used to maximize the resource rent—the profits gained from fishing after the costs of hunting the fish and returning them to port were subtracted from their landed value (*see* Figure 4.2).

The expanding competition in the fishing industry that concerned fisheries biologists in the 1950s, and which formed the underlying assumption of profit seeking human behaviour in Gordon's bioeconomic models, was directly tied to the effects of industrial modernization. The gradual industrialization of the inshore fishery and the arrival of foreign offshore draggers on the Grand Banks dramatically increased the ability to locate and kill cod in the post-World War II period[12]. Adding to the competition associated with new fishing technologies was the shift away from the subsistence-merchant economy towards a reliance on wages and cash in an expanding market economy that left fishers with decreasing access to merchant credit and their traditional adaptive strategies associated with occupational pluralism. For those who remained in the modernized fishery, technological abilities and economic pressures to catch fish and turn them quickly into cash before they were killed and sold by someone else threatened

[12] Beginning in the early 1950s factory freezer stern trawlers arrived to fish for cod on the offshore banks as well as in inshore Newfoundland waters, sometimes inside the three mile territorial sea (Hutchings *et al.* 2002). "Between the 1950s and the late 1960s, the total [reported] catch of Northern cod by all countries almost tripled, reaching an historic maximum of 810,000 tonnes in 1968" (Hutchings and Myers 1995:58).

to both over-exploit cod populations and result in poor fishers who spent more to win the race to fish than they could earn from selling the fish when they returned to shore (Holm 2001).

To obtain the maximum sustainable yields promoted by biologists, or the maximum economic yields advocated by the economists, the fishery had to change. Bio-economic models pointed to several ways that the fishery could be altered to achieve maximum yields ($E_{msy}$ or $E_{mey}$ *in* Figure 4.2); however, all of the proposals required fundamental changes to the centuries old Freedom of the Seas law—*Mare Liberum* (Holm 1996)[13]. In order to obtain maximum yields, economists argued that fish populations had to be owned as if they were swimming inventories. Without ownership there was no incentive for fishers to act in an economically or biologically rational way and bring their fishing effort in line to achieve maximum yields. Ownership would produce the predictable, economically rational fishing behaviour assumed in the bio-economic models, however it was impossible to achieve if access was freely available to all. If fish populations were not owned, it was argued, there would be a race to fish, and a tragedy of the commons would ensue[14]. However, if fish populations were owned by a single actor with the power to exclude others from fishing, maximum economic or sustainable yields could be obtained indirectly through the imposition of resource or effort taxes, or directly by limiting access and effort in the form of quotas, licences or

[13] Mare Liberum, or the Freedom of the Seas principle, was codified by the Dutch born Hugo Grotius in 1633 with reference to the freedom of the Dutch to take part in the lucrative marine trade with East India. The principle was first established by the Romans and it gave unrestricted use of non-territorial seas for naval and commercial navigation and fishing in times of peace (Grotius 1633).

[14] Hardin's (1968) Tragedy of the Commons argument was extremely influential in cod fisheries management and the warnings contained in his 1968 article appeared to be playing out exactly as he predicted in Newfoundland and Labrador. It is a sad coincidence that 1968 saw the largest landings of Northern cod ever recorded as numerous national fishing fleets competed to land over 800,000 metric tons of cod on the fishing banks off Newfoundland and Labrador.

gear restrictions (Holm 1996). According to the bio-economic models, "a fishery left to itself will always be suboptimal. The structure of the situation thus requires external intervention" (Holm 1996:182).

After one hundred years of state-sponsored fisheries research, by the 1960s scientists had finally provided governments with knowledge of how to control landing fluctuations in cod. By representing fish as statistical populations and developing quantitative bio-economic models, they were able to predict future abundance under a variety of fishing regimes and give advice to governments on the most optimal fishing levels for given biological or economic goals. National governments, however, were unable to implement the knowledgeable recommendations of fisheries scientists because they did not have the right under international law to take ownership of fish populations beyond their small territorial sea zone that only extended to 3 miles offshore. The bulk of the cod populations were identified as being located far offshore on the continental shelf. For effective cod fisheries management to exist, the knowledge of scientists had to be connected with vast new territorial powers that granted property rights and ownership responsibilities to the Canadian state[15].

On January 1st 1977, Canada declared a 200 mile Exclusive Economic Zone (EEZ) off its east and west coasts—overnight the majority of the Northwest Atlantic cod populations fell within Canada's national territory (Lear and Parsons 1993). Canada justified the massive extension of its national territory in the name of creating the conditions for effective fisheries management. If the tragedy of the commons was to be

[15] As Petter Holm (1996:182) observes, fisheries management "builds on a partnership between science and the state. Science must establish the facts: how large are the stocks? Which effort level will give the optimum return? The state must, besides funding science, regulate the fishermen's activities and prevent them from destroying their economic basis."

avoided among fishers on the fishing grounds and among states around the international negotiating table, national ownership of the cod populations had to be established (Holm 1996). Once ownership was vested in the Canadian State, the promising knowledge of fisheries scientists could be linked up with state power to produce effective fisheries management that put an end to fluctuations in landings and the threat of overfishing.

While total allowable catch (TAC) limits for Northern cod in 2J3KL (*see* Figure 4.1 *on page 110*) had been introduced by the International Commission for Northwest Atlantic Fisheries (ICNAF) in 1973, they were extremely difficult to enforce, compliance was voluntary, and the ICNAF did not possess the capability or legal right to enforce its recommendations leading to frequent violations of the recommended TAC (Lear and Parsons 1993). Once Canada declared its EEZ, the newly established federal Department of Fisheries and Oceans (DFO) immediately reduced total allowable catch levels and enforced a significant drop in cod fishing activity to permit cod populations to rebuild (Finlayson 1994). DFO eventually established quotas, licences, and gear restrictions for the cod fishery to bring landings in line with TAC levels that would produce maximum yields[16] (Lear and Parsons 1993). Once the foreign fleets had been removed from Canada's EEZ, the Federal and provincial government began subsidizing the development of an offshore cod fishing fleet to permit the development of a year round harvesting and frozen processing industry in Newfoundland and Labrador (Vardy and Dunne 2003). Population survey data from the offshore and predictions of population

[16] TAC levels were eventually set at the $F_{0.1}$ level which were originally "developed in ICNAF as a more conservative replacement for the concept of Maximum Sustainable Yield (MSY) as a management goal" (Finlayson 1994:29). DFO (1988:22 *quoted in* Finlayson 1998:29) defined the concept in the following way: "…$F_{0.1}$ is the level of fishing effort at which adding one more boat would result in increasing the total catch by only 10 percent as much as the very first boat to fish that stock… $F_{0.1}$ is a useful idea in fisheries management because it does two things the old 'maximum sustainable yield' did not. It takes some account of the economics of fishing and it leaves a wide margin of biological safety."

rebuilding from bio-economic models indicated that huge surpluses of cod would become available to be caught by the 1980s (Finlayson 1994). The rules surrounding the EEZ dictated, however, that any surplus cod which was not removed by Canadian fleets had to be made available to NAFO members[17]. This stipulation encouraged the rapid development of Canadian fleets to capture as much of the TAC as was feasible.

After declaring the 200 mile limit, Canada had finally created the conditions to implement an effective fisheries management regime. While inshore fishers complained of declining catches in the early 80's (when cod populations had supposedly recovered) offshore surveys reported increasing catch-per-unit-efforts, indicating that cod populations had rebuilt and were abundant offshore. The complaints from inshore fishers of declining catches were assumed to be caused by changes in cod migratory behaviour, hypothesized to be the result of changes in water temperature and salinity that supposedly blocked their migrations inshore. Furthermore, the bulk of the northern cod populations were assumed to be located on the offshore banks and all indications from scientific surveys and data from the offshore commercial fleet indicated that cod populations were abundant and able to sustain large TAC levels. The abundance of cod offshore led fisheries management efforts to focus on regulating the offshore fleet with the introduction of licensing, quota allocations, gear restrictions, and seasonal limits. Management measures came later to the inshore and received less attention compared to the highly productive and tractable offshore cod populations and fishing fleets.

[17] NAFO, the North Atlantic Fishery Organization, replaced the ICNAF in 1979 as the lead international agency responsible for Northern cod management.

By the 1980s, the development of cod fisheries management had resulted in a "silent revolution" in Newfoundland and Labrador[18]. All indications were that fish and fishers had been effectively domesticated, represented as quantifiable elements in predictable and controllable population dynamics models. The identities of both cod and fishing people "as well as the relationship between the two" had "been deeply transformed" (Holm 2001:10). The birth and development of cod fisheries management from Sars's original scientific studies of the fish in the 1860s up to the modern bio-economic models had occurred in tandem with industrial modernization. The number of people hunting cod fish for a living in Newfoundland, the tools they used, and the numerous sparsely populated outport communities they had once lived in had all dramatically changed.

> [Before fisheries management]...a major barrier for those who wanted to be fishers had to do with the physical and mental hardships of this occupation. Becoming a fisher entailed the hardening of body and mind to tolerate long working hours and gruelling physical exertions, long periods away from home and family, great risks to personal safety and health. While many fishers nowadays suffer similar hardships, prospective fishers are also forced to cross barriers of a different kind, like the bureaucratic jungle of rules and procedures that must be negotiated in order to become owners of fishing vessels and holders of licenses and quotas (Holm 2001:10).

The cod had changed too. Before the advent of fisheries management, cod were understood as a free species embedded in an uncommodified common ocean—nobody owned cod until they were hunted down and pulled onboard a fishing vessel. After the spread of population thinking, the development of population dynamics models and the establishment of the 200 mile EEZ to permit effective fisheries management, Northern cod became members of large swimming inventories whose current and future biomass and economic value could be assessed onshore long before they were killed by a fisher or

[18] The term "Silent Revolution" is borrowed from Petter Holm's (2001) dissertation title of the same name. He used the term to designate the revolutionary transformations that followed the introduction of fisheries management into the Norwegian fishery at the end of the 1970s.

their mother had even laid an egg for fertilization offshore. Managers in St. John's or Ottawa need not ever set foot on a fishing boat to control fluctuations in landings—by modeling cod populations, fishers and the relationships among them, productivity could be planned into existence from a "center of calculation" (Latour 1987). The establishment of fisheries management changed the identity of fisherpersons from "fish killers," hunting a wild species on the edge of modern society, to modern license holders and quota owners running businesses in the midst of a modern market society. The establishment of fisheries management also changed the knowledge that was considered important to enable fishers to carry out the practice of fishing.

> Even if you are a successful fisher, that does not qualify you as a fish expert. After the breakthrough of fisheries resource management, the fish expert is unequivocally a scientist, usually a natural scientist trained in fisheries biology and oceanography. It is no longer the practical knowledge of how to find and catch fish that equals expertise, but the command of scientifically certified methods and models designed for measuring and predicting the size of fish stocks (Holm 2001:11).

However, despite all of these changes and the managerial perception that wild cod had become known populations and that cod fishers interacted with them as if they were predictable economic actors, fisheries management was ultimately based on assumptions that wild cod and fishing people had no interest in or obligation to obey.

## 4.5 The Managed Annihilation of *Gadus morhua*

> The population activities launched since the 1960s have turned out to be dreams that brought forth monsters (Duden 1992:155)[19].

> ...the Atlantic Canadian groundfish stocks have collapsed, despite the presence of an elaborate stock assessment and management regime (Hutchings *et al.* 2002:140).

In 1988, after numerous inquiries into the Northern cod fishery, persistent claims from inshore fishers that TACs were being set too high (Finlayson 1994), and an

[19] While Duden (1992) is describing human population control programs launched in the developing world, in retrospect the population models applied to Newfoundland and Labrador cod fisheries appear similarly monstrous in their effects.

independent assessment of DFOs stock assessment data (Keats *et al.* 1986), the Minister of Fisheries and Oceans ordered an official report to review the estimates of northern cod abundance that had formed the basis of Canada's cod fisheries management regime. The resulting Alverson Report claimed that while northern cod populations had increased since 1977, the stock assessments had massively overestimated the health of northern cod populations in 2J3KL (*see* Figure 4.2). This shocking admission of error, from a government sponsored report, resulted in a northern cod enquiry called the Harris report which published its findings in 1990. After taking into consideration both the biological and economic implications of a cut in cod landings the Harris report recommended a modest reduction in TAC levels from 235 000 to 190 000 tonnes (Harris 1990). However, "during the 1992 fishing season it became apparent that there was little left to catch. The situation was far worse than even the most pessimistic projections" (Macgarvin 2002:22). On July 2, 1992 after the Canadian offshore dragger fleet was unable to find enough cod to even come close to meeting their quotas, Federal Fisheries Minister John Crosbie was forced to announce the closure the northern cod fishery after close to 500 years of uninterrupted fishing activity. The closure of the fishery resulted in massive social upheaval and a significant delegitimization of DFO's population dynamics models, leading to a plethora of critiques of fisheries management and a reassessment of the assumptions in the models used to manage the fishery.

The careful creation of a world-renowned cod fisheries management system originating with the work of Sars in Norway in the 1860s, Heincke's population thinking at the end of the $19^{th}$ century, the bio-economic systems models of the 1950s, and the declaration of a 200 mile EEZ in 1977 had tragically produced what it was designed to prevent. Rather than bringing stability to fish landings, it had eliminated landings altogether. The next three chapters explore the major responses to this massive failure of managerial ecology and discuss the numerous proposals for new forms of cod fisheries management to establish sustainable cod production.

# CHAPTER 5

## Success Through Failure: Cod Fisheries Management After the Moratorium Crisis

> I felt and still feel it was the opportunity for the government to change the management of the fishery. – John Crosbie[1]

Changes that have occurred in cod fisheries management since the 1992 moratorium are paradoxical and counterintuitive. The collapse of the commercial cod fishery resulted in the largest single layoff in Canadian history, socio-economic crisis, and irreversible ecological change. However, rather than de-legitimizing managerial approaches to fisheries, or catalyzing the end of cod fisheries management, the annihilation of what was once thought to be the world's most successful scientifically managed fish stock has produced an expansive managerial ecology.

The paradigmatic case of scientific fisheries management failure has ironically coincided with the most profitable and modernized seafood industry in Newfoundland and Labrador's history with roughly half the number of pre-1992 fishers competing for a lucrative new crustacean fishery. Furthermore, despite over a decade of cod fishing moratoria, wild stocks have continued to plummet prompting scientists to recommend that the Northern cod be declared an endangered species (COSEWIC 2003, SARA 2004ab). Meanwhile, provincial and federal governments have enthusiastically partnered with the private sector to develop industrial cod aquaculture complete with an aptly

---

[1] John Crosbie, the Federal Fisheries and Oceans Minister who announced the cod fisheries moratorium in 1992 (Quoted *in* Blades 1996).

located hatchery in *Conception Bay* capable of artificially spawning 6 million domesticated cod for annual grow out[2].

Many changes in cod fisheries management have occurred since 1992: (1) wild cod and their dynamics are no longer confidently controlled, rather they are increasingly targeted for managerial coping; (2) subsistence food, as well as directed commercial cod fishing activities are increasingly criminalized and restricted; (3) industrial cod *hunters* proficient at efficiently killing fish have been encouraged to either leave the industry or become responsible stewards-of-the-sea acting as entrepreneurial, self-managing professional fish *harvesters*; and (4) cod have been domesticated, placed into highly controlled artificial systems that husband their biology with the goal of producing profitable *egg-to-plate* industrial farming operations. While these developments are contested and have been unevenly implemented, the "opportunity" to develop new forms of fisheries management, identified by John Crosbie in the opening quote, has not been squandered.

[2] *North Atlantic Sea Farms* operates a cod hatchery in Bay Roberts, Placentia Bay on the south east coast of Newfoundland. The Atlantic Canada Opportunities Agency (ACOA) has supported the development of the Hatchery with over one million dollars in Federal funds.

## 5.1 Cod Fisheries Management After the Collapse: A New Regime Finds Its Sea Legs[3]

> We are not witnessing marginal shifts or routine variations, but more fundamental changes. There is little prospect that things will settle down or return to normal. Two interrelated but somewhat contradictory processes are at the centre of these changes. First is the development of highly competitive global markets. Second is the diminishing role of state governance in fisheries and the growing legitimacy of market mechanisms (Apostle *et al.* 1999:3).

The collapse of the Northern cod fishery in 1992 coincided with a number of fundamental ecological, economic, political, social, philosophical and scientific shifts. New paradigms and ideological developments in the global seafood economy, government, management science, and ecological science have influenced the meanings and practices of cod fisheries management. The sudden collapse of the modern cod fishing economy and way of life in 1992 coincided with a parallel rise in neo-liberal governance in Canada and globalized capitalism around the world. Subsequently, market as opposed to state-led managerialism became the focus of reforms in fisheries management and other state functions (Neis 1991, Jessop 2002, Parker 2002, Bavington *et al.* 2004). The emphasis on market managerialism significantly influenced responses to the failure of the cod fishery in Newfoundland and Labrador[4].

Throughout the 1990's, political and economic changes prompted governments and private sector corporations to de-emphasize hierarchical and bureaucratic

[3] "Finding your sea legs" is a colloquial fishing term used to describe the feeling fishers go through when they have been on the ocean long enough to adjust to the movements induced by ocean swells. Before you "find your sea legs" you often feel sick to your stomach and can not function well on the water (Palsson 2000).

[4] Parker explains that market managerialism involves a "... conception of management as being the only group, practice and intellectual discipline that is capable of responding to the stern demands of accelerating market societies...[T]he story of globalizing turbo-capitalism, the breakdown of old slow certainties and the constancy of change leads to the conclusion that new experts are required. These experts will be a global managerial class... sent out to remodel the world. Like a new cohort of Jesuits, their missionary zeal will spread the message that the market is now king, and management its representative on earth. To be happy, efficient and progressive their mission must be embraced...According to this logic, introducing the market into areas which were previously outside the market is both wise and inevitable since it can help to ensure both efficiency and customer satisfaction [while implying that] there is an ahistorical hidden hand that pushes and pulls in the same manner everywhere" (Parker 2002:184-185).

organizational forms in favour of flat organizational structures, creative learning organizations (Senge 1990) and flexible self-managing entrepreneurial teams focused on quality, excellence, customer satisfaction, creativity and continuous improvement (Peters and Waterman 1988, Crainer 2000). The relative economic decline in Fordist manufacturing profitability throughout OECD (Organization for Economic Co-operation and Development) countries, originating with the OPEC (Organization of the Petroleum Exporting Countries) induced oil crisis in the 1970s and economic recession in the 1980s, led to declines in raw commodity prices and the emergence of profitable new industries in information technology, biotechnology and other "knowledge" sectors (Neis 1991, Apostle *et al.* 1998, Jessop 2002).

The shift away from Fordist mass production to post-Fordist niche goods, services and knowledge delivery exerted pressures on the seafood processing and fishing sector to come in line with highly competitive, complex and turbulent global markets[5]. Newfoundland's modernized seafood production processes that previously focused on exporting high-volume, relatively low-value mass produced frozen cod blocks to bulk-purchasing institutional customers, became an economic liability as markets differentiated throughout the 80's and the wild cod resource collapsed in the early 90's (Neis 1991, Apostle *et al.* 1998). Business management theories and rhetoric that advised corporations how to achieve profitability in turbulent, highly competitive, globally integrated markets had to shift their advice to companies. Rather than focus on efficiently manufacturing standardized, mass produced goods that relied on cheap natural resources and low skilled labour, Newfoundland fishing corporations were encouraged to

[5] Apostle *et al.* (1998:7) observe that while the cod fishery was "[a]lways oriented towards export trade, fish markets are [now] becoming truly global, as are parts of the fishing fleet and processing industry."

shift towards the flexible production of a diversity of fresh and value-added consumer seafood products to meet discriminating consumer demands (Apostle *et al.* 1998, Sackton 2003, Rowe 2004ab).

The collapse of the Soviet Union in 1989, neo-liberal ideology, economic globalization, and the gradual decline of welfare states dramatically altered the political-economic context within which fisheries management operates. Jessop describes these broad political and economic changes as the shift from Keynesian welfare national states (KWNS) to Schumpeterian workfare post-national regimes (SWPR) (*see* Table 5.1 *on page 128 for a detailed explanation of these changes*).

In the name of reducing government deficits and debt and in the context of wide-ranging restructuring of the welfare state, the Canadian government increasingly shifted from an emphasis on providing socially insured welfare benefits crucial for fishery and other seasonal workers to an individualized high risk workfare society throughout the 1990s. Un-employment insurance benefits were reduced, eligibility requirements tightened, and state-led programs, such as DFO's fisheries management mandate, began to be conceptualized along the lines of for-profit insurance businesses[6].

[6] A number of government services, including fisheries management, were encouraged to move toward user-pay cost recovery as opposed to relying exclusively on government funding through general tax revenues. The *Un*employment Insurance (UI) program was renamed in 1996 to the *Em*ployment Insurance (EI) program. The restructured program significantly tightened up eligibility requirements and reduced benefits, taking the emphasis off universal insured benefits for unemployed workers toward job-skills training services and rapid re-employment (Government of Canada 2004). The EI program aimed at cutting costs for the Federal government and resulted in thousands of unemployed and seasonal workers losing their eligibility for EI benefits as well as increased EI premiums for employers and employees. In 2004, the renamed Employment Insurance program had accumulated over 44 billion dollars in surplus funds and was a source of revenue for the Federal government, taking in 3 billion dollars more in premiums than it paid out in benefits (Bailey 2004).

**Table 5.1** An idealized picture of the Keynesian welfare nation state (KWNS) and the Schumpeterian workfare postnational regime (SWPR) with examples from the Newfoundland cod fishery. (Adapted from Jessop 2002:59,252, Apostle *et al.* 1998, Wright 2001 and Bavington *et al.* 2004).

| **Distinctive Set of Economic Policies** | **Distinctive Set of Social Policies** | **Primary Scale (If Any)** | **Primary Means to Compensate Market Failure** |
|---|---|---|---|
| *Keynesian*<br><br>✓Full employment ("social fishery" as employer of last resort).<br>✓Demand management (Subsidies to develop markets).<br>✓Provision of infrastructure to support mass production and consumption (Modernization of fish processing (cold storage and freezing) technology and fishing practices including loans for boats and gear). | *Welfare*<br><br>✓Collective bargaining (Emergence of fishery unions) and state help (welfare benefits for fishery workers) generalize norms of mass consumption (modern consumer society and relocation of outports into "growth centers").<br>✓Expansion of welfare rights (EI for seasonal fishery workers). | *National*<br><br>✓ Relative primacy of national scale in economic and social policy-making with local as well as central delivery (Fish trade regulated and subsidized with numerous trade barriers). | *State*<br><br>✓Market and state form a mixed economy. State is expected to compensate for market and ecological failures (Government investment and bail outs for fish corporations and unemployed fishery workers in 1950-1970s with economic crisis in the 80's when Fishery Productions International and National Sea Products were consolidated from over ten processing firms). |
| | | | |
| *Schumpeterian*<br><br>✓Focuses on innovation and competitiveness in open economies (value added products combining seafood from around the world and from both capture and cultured fisheries).<br>✓Increasing stress on supply-side to promote knowledge based economy (Focus on quality of supply with bias toward farmed species and retraining of wild fish harvesters and plant workers to emphasize quality in capture and handling). | *Workfare*<br><br>✓Subordinates social policy to an expanded notion of economic policy (Reduce number of people in the fishery to permit profitability and competitiveness).<br>✓Downward pressure on the 'social wage' and attack on welfare rights (Reform to UI and cutbacks to DFOs operating budget—"doing more with less"). | *Postnational*<br><br>✓Relativization of scale at expense of national scale (Raw white fish sourced globally and assembled into value-added products in NL fish plants).<br>✓Competition to establish a new primary scale but continued role of national state(s). (Consolidation of seafood corporations and global sourcing and marketing of product). | *Regime*<br><br>✓Increased role of self-organizing management to correct both for market and state failures (Increased downloading of management responsibility onto resource users and moves toward individual transferable quotas and aquaculture).<br>✓State gains greater role in the exercise of metagovernance/ context design, facilitation and steering (DFO creates conditions for self-organization by reducing and redefining what constitutes legal fisherpersons and "fishery" definition is expanded to include capture *and* culture). |

Rather than receiving increased resources for fisheries management after the moratorium, the Department of Fisheries and Oceans (DFO) and other government departments were asked to "do more with less." DFO's budget was cut, reducing its capacity to conduct scientific research, monitoring, and policing, and it was burdened with additional managerial responsibilities in the decade after the moratorium. In addition to enforcing cod fishing restrictions and outright bans, DFO had its mandate broadened to include integrated, ecosystem-based oceans management under the Ocean's Act (DFO 1996) and Strategy (DFO 2002b)[7].

In addition to these economic and political developments, influential ecological metaphors, scientific theories and fishery models were also changing around the time of the cod collapse. From an emphasis on equilibrium-based, predictive, Newtonian models, ecological science began to advocate non-linear complex systems approaches focusing on disturbance, irreducible uncertainty, adaptability and change (Botkin 1990, Golley 1993, Lewin 1993, Worster 1993,1994, Capra 1996, Levin 1999). The popularization, interpretation and spread of these new scientific ideas was enabled and influenced by cultural, political and economic trends that emphasized turbulence, disturbance and change associated with the rise of markets and the demise of state planning as the favoured management tool for ordering socio-economic and ecological relations (Worster 1994, Apostle *et al.* 1998, Rosenhead 1998). Just as Darwin's 19th century scientific theory of natural selection was influenced by the ideas of Malthus (whose theory of population growth and resource scarcity was concerned with the social and economic conditions at the center of the enclosure movement and changes

[7] The Oceans Act (DFO 1996) and Strategy (DFO 2002b) expanded the responsibility of DFO and increased the scope of management to include a multitude of ocean uses in addition to fisheries. "...the *Strategy* is based on three principles of sustainable development, integrated management and the precautionary approach. These three principles should guide all ocean management decision making" (DFO 2002b:10). The Oceans Strategy and its emphasis on ecosystem-based management requires DFO to do a lot more with a lot less in term of budgetary support. The need to do "more with less" is a central theme in neo-liberal forms of governance and is connected with a broadening out of responsibility for ocean management. Canada's Oceans Strategy stresses that "...oceans governance...is much more than a federal government responsibility. It is a collective responsibility shared by *all*" (DFO 2002b:18 *emphasis added*). Neo-liberal themes of distributed responsibility and increases in the number of actors understood to be fisheries managers will be discussed in greater detail in chapter six.

surrounding the industrial revolution in Britain), complexity theory, post-Newtonian ecology and their application to fisheries management were influenced by currents of thought embedded in late 20th century social and economic circumstances (Rosenhead 1998, Ross 1998, Thrift 1999). As Rosenhead (1998:15) observes:

> The past 20 years have not only seen the mushrooming of interest in complexity theory. They have also been years in which a hegemonic common wisdom has developed, in favour of the market rather than planning as the way to order our affairs; in which the demise of the Soviet Union has consolidated this victory in geo-political terms; in which mass production of standard products has been replaced by Post-Fordist fluidity in promoting and responding to changes in taste and fashion; in which influential thinkers have mounted an assault on the pre-eminence of [expert] reason in social decision making…;and in which postmodernism has made good progress in sweeping such notions as 'progress' off the agenda of respectable discourse. All of this makes a theory which appears to argue that the future is *in principle* unknowable and therefore unplannable an extremely welcome menu item at the intellectual dinner table. It appears to add the authority of science to pronouncements that "there is no alternative" to the market.

Beginning in the 1970's, the field of ecology began to reject the equilibrium view of a world of ecosystems tending towards balance and began focusing on disturbance, "…especially signs of disturbance that were not caused by humans" which could be framed as "natural" (Worster 1995:72). Scientific research into the reasons behind the cod collapse reflected shifts away from equilibrium thinking towards disturbance-based explanations and resulted in DFO emphasizing the importance of climate variability for cod stock recruitment and recovery (ICES 2003ab, NRC 2003, Rose 2003, Colbourne 2004). Rather than placing the emphasis on human-induced disturbance caused by over-fishing and other industrial marine activities, natural variability and unmanageable environmental change (primarily colder than normal sea temperatures in the 1980s) became the favoured DFO explanation for the cod fishery collapse[8]. While over-fishing

[8] While DFO and other international fisheries organizations recognized the importance of over-fishing as a contributing factor in the cod collapse, climatic fluctuations and water temperature change were accorded primary significance (Steele *et al.* 1992, Hutchings and Myers 1995). This has continued even after historical research by fisheries biologists Hutchings and Myers (1995) showed that water temperatures were lower in the 19th century with no observable effects on either cod recruitment or fish landings.

drew attention to scientist's failure to accurately predict fish stocks, and manager's inability to control industrialized fishing effort effectively to bring landings in line with careful use (sustainable exploitation), environmental change was outside human control and therefore beyond managerial responsibility.

Focusing on fluctuations in water temperatures as the driving factor behind the cod collapse took the emphasis off fisheries managers and their socio-economic and political context thus legitimizing a program of reformed science and management as the magic bullet for solving the fishery crisis. The largest layoff in Canadian history and the failure of cod fisheries management therefore did not lead to a single public inquiry or Royal Commission into the reasons behind the annihilation of the Northern cod—despite the fact that numerous inquires had been undertaken into the cod fishing industry in the years prior to the moratorium.

While DFO managed officially to depoliticize the cod collapse and deflect blame from itself by emphasizing environmental explanations for the collapse, the Department had to respond to demands from fishers for a more inclusive role in stock assessment, fisheries science and management in a climate of government fiscal restraint and market managerialism. DFO began to experiment with increased public consultations, stakeholder negotiations, the use of self-organizing market mechanisms, and the inclusion of inshore fish harvesters in data collection and co-management arrangements rather than the traditional emphasis on the offshore dragger fleet and top-down bureaucratic structures centrally located in Ottawa. These changes helped to form a new fisheries management discourse that responded to the cod collapse in ways that were compatible with neo-liberal restructuring of government and the emphasis on market managerialism.

Contemporary cod fisheries management in Newfoundland and Labrador deploy *both* a critical language against top-down, State-led, command and control bureaucratic management *and* an affirmation of market-focused entrepreneurial relationships and distributed responsibility through participatory, stakeholder-led bottom-up management. This type of management emphasizes the careful use and stewardship of domesticated and wild cod fisheries, while coping and adapting to uncertainty, flux and change in seafood markets and ecosystems that contain endangered wild cod stocks. The single-species wild fish population model has given way to a multi-use ecosystem approach with numerous sub-populations of inshore and offshore cod. Uncertainty and fluctuation in fish landings and seafood markets, once targeted for elimination and control, are increasingly accepted as realities demanding innovative coping strategies and adaptations. Large scale, non-linear change and hierarchically nested, unpredictable processes such as climate change, localized fish populations, market demand, fishing down sequences, foreign over-fishing beyond the 200 mile EEZ, by-catch and the complexity of wild cod recovery emphasize uncertainty and flux over predictability and equilibrium. Transformation from a welfare-Keynsian to a workfare-Schumpterian capitalist state (Jessop 2002) that emphasizes "steering" versus "rowing" has led to the facilitation of *possibilities* as opposed to the delivery of *predictions* and their associated guarantees such as stable quota allocations, fish processing employment, fisheries monitoring, management, and other welfare goods and services.

The need for steady fish landings and the industrial jobs associated with them was one of the main reasons for the birth and development of fisheries management at the turn of the 19th century. However, since 1992 fisheries managers in Newfoundland and

Labrador can no longer predict cod stock recovery or guarantee cod landings to support a modern cod fishing economy and society. Fisheries management in many ways has produced what it was designed to prevent—a cod fishing closure, massive unemployment, and high levels of uncertainty and fluctuations associated with codfish recovery. These changes have undermined faith in control-oriented cod fisheries science leading to proposals for a new form of science and management to cope with wild cod and the fluctuating and uncertain eco-social contexts they are now increasingly understood to be embedded within.

### 5.2 Depleted Fisheries Systems in an Age of Neo-Liberal Globalization: The Rise of a New Science to Cope with Endangered Cod

In an age of consolidated vertically integrated seafood corporations, industrial capture and culture fisheries, declining wild fish populations, shifting government policies and unpredictable biophysical changes operating at a planetary scale, the complexity and uncertainty of fisheries systems in Newfoundland and Labrador has never been greater. In the face of the Northern cod and other global stock collapses[9], budgetary restraints, and extreme over-fishing of species thought to be managed effectively, national fisheries managers are increasingly left to cope and adapt to failures as opposed to taking a confident proactive stance towards fisheries under their managerial control (Ludwig *et* al. 1993, Thompson and Trisoglio 1997, Finlayson and McCay 1998, Ludwig 2001, Bavington 2002, McCay 2002a). The global fisheries crisis, in which the

[9] Globally, human beings now expropriate close to 35% of all marine primary productivity. The biomass extracted from marine ecosystems is used for direct human consumption as well as use in aquaculture and terrestrial farming for feeds and fertilizers (Pauly and Christensen 1995, Naylor *et al.* 2000, Pauly *et al.* 2001). In 2002 and again in 2004 the Food and Agriculture Organization of the United Nations reported that roughly 75% of the worlds fisheries were either exploited to their maximum level or had been over fished to the point of stock collapse (FAO 2002, 2004).

Newfoundland and Labrador cod collapse is situated, involves interconnected biophysical, social and political complexity (Caddy and Regier 2002, Barange 2003, Bavington *et al.* 2004).

Attempts to address the complexity within fisheries management broadly, and cod fisheries management in particular, have revolved around calls to move from single species to ecosystem-based management. Ecosystem-based fisheries management emphasizes modeling a wider number of variables beyond commercially relevant fish populations, and integrating a diversity of knowledge outside traditional fisheries biology and economics such as the experiential knowledge of fishers, interdisciplinary science and the concerns of environmentalists (Neis 1992, Pitcher *et al.* 1998, Neis *et al.* 1999ab, Neis and Felt 2000, Charles 2001, DFO 2002b, Berkes 2003, McCay 2002a, FAO 2003ab, Garcia *et al.* 2003, Latour *et al.* 2003) (*see* Table 5.2 *on page 135*).

The need to address irreducible uncertainty with respect to scientific knowledge (Kay and Schneider 1994), regime shifts (Steele 1998, Scheffer *et al.* 2001), fishing down theory (Pauly *et al.* 1998, Caddy and Garibaldi 2000), hierarchical nesting from the local to the global across system types and temporal scales (Boyle *et al.* 2001) and the inclusion of a range of knowledge-types and forms of stakeholder participation in the management process (Neis and Felt 2000, McCay 2002a), has raised continuing challenges for the implementation of ecosystem-based fisheries management in Newfoundland and Labrador and around the world (FRCC 1997, Link 2002, Garcia *et al.* 2003).

**Table 5.2** Comparison between single species and ecosystem-based fisheries management (Adapted from Busch *et al.* 2003, Garcia *et al.* 2003, Bavington 2002, Bavington and Kay 2003, 2005).

| *Criteria* | | *Single Species Fisheries Management* | *Ecosystem-Based Fisheries Management* |
|---|---|---|---|
| **Management** | | Sector-based. Control oriented: aimed at target commercial species and harvesters (Harvest regulation). | Area-based. Coping Oriented: focusing on habitats, ecosystem integrity and facilitating the self-control of people. |
| **Governance** | **Objectives** | Not always coherent or transparent. "Optimal" system output focused on commercial fish production. | A desired state of the ecosystem (health, integrity). Conservation, rebuilding of depleted stocks and risk management. |
| | **Scientific input** | Formalized (particularly in regional commissions). Variable impact. Population Statistics | Less formalized. Less operational. Often insufficient. Stronger role of advocacy, forensic science, and local ecological knowledge. |
| | **Decision-making** | Most often top-down. Strongly influenced by industry lobbying. | Promotes bottom-up, participatory approaches and market mechanisms. More opportunity for influence by environmental lobbies. Stronger use of tribunals and councils. |
| | **Role of the media/PR** | Historically limited. Growing as fisheries crisis spreads. | Stronger use of the media, public relations and facilitation techniques. |
| | **Local, regional and global institutions** | Central role of the Food and Agriculture Organization of the UN, regional fishery bodies (e.g. NAFO) and National Fishery departments (e.g. DFO). | Central role of United Nations Environment Program (UNEP), the Regional Seas Conventions and partnerships between different levels of government, including municipal scale and industry self-management. |
| **Geographical basis** | | A process of overlapping and cascading subdivision of the oceans for allocation of resources and responsibilities. (e.g. NAFO subdivisions 2J3KL). | A progressive consideration of larger-scale ecosystems for more comprehensive integrated management. (e.g. from specific areas with bay stocks to entire coastal zones and Large Marine Ecosystems (LME)). |
| **Stakeholder and political base** | | Narrow. Essentially fishing industry stakeholders. | Much broader. Society-wide. Often with support from subsistence, recreational and small-scale fisheries. |
| **Global instruments** | | 1982 Law of the Sea Convention, UN Fish Stock Agreement and FAO Code of Conduct. | Ramsar Convention, UN Conference on Environment and Development and 1992 Agenda 21, Convention on Biological Diversity and Jakarta Mandate. |
| **Measures** | | Regulation of fishing activity outputs (removals, quotas) or inputs (gear, effort, capacity) to maintain resource productivity and trade benefits. | Protection of specified areas and habitats, including limitation or exclusion of extractive human activities. Total or partial ban of some human activities. A focus on controlling human interaction with marine resources versus the resources themselves. |

Fisheries scientists and international fishery organizations are increasingly becoming aware of the immense challenges associated with ecosystem-based fisheries management in the Northwest Atlantic as over-fishing, environmental fluctuations, climate change, and scientific uncertainty interact and amplify the number of variables that need to be predicted if managerial control is to be achieved. As Barange *et al.* (2003:26) of the *Global Ocean Ecosystem Dynamics Project* (GLOBEC) observe "not only do environmental and human factors separately affect fish population dynamics, but these two sets of factors interact, compounding their effects." Pauly and Maclean (2003) summarize the managerial challenges posed by dynamic interactions between over-fishing, shrinking food chains, and environmental fluctuations in their book on the North Atlantic ocean:

> Long food chains are disappearing, leaving mainly shorter ones...This may appear to be an academic point, interesting only to food web theoreticians, but it has, in fact, important practical consequences. Notably, shorter food webs expose top predators to the strong, environmentally driven fluctuations exhibited by the plankton organisms at the base of food webs, fluctuations which were previously dampened by food webs with a variety of strong and weak links...[T]he fishes that fisheries target tend to feed directly on a few species of plankton-feeding fishes, and these are far more exposed than previously to seasonal and between-year changes of plankton abundance. Thus the fish species targeted by fisheries, earlier very predictable in terms of their biomasses, now fluctuate more widely than before. This effect, moreover, has been amplified by the scarcity of old specimens in the exploited populations, whose magnitude, therefore, tends to vary with reproductive success, i.e. the entry of young fish ("recruits") into the populations. *Combined, these two effects make catches even harder to predict, and fisheries more difficult to manage than they already were* (Pauly and Maclean 2003:53,54,56 *emphasis added*).

In addition to the complex biophysical dynamics emphasized by Pauly and Maclean, fisheries managers are faced with challenges that include an array of interconnected socio-economic, legal and political systems flowing from a diverse set of historical circumstances, operating at a variety of spatial and temporal scales with differing goals, levels of influence, and power. The task of managing endangered cod embedded in the wild Northwest Atlantic marine ecosystem, as opposed to idealized cod populations in abstracted equilibrium-based models, presents enormous challenges that are only beginning to be explored. Since the mid 1990's ecosystem-based approaches of various types have presented themselves as alternatives to single species models that—despite their many identified failings—continue to influence how management is perceived and implemented in fisheries systems throughout the world (FRCC 1997, Caddy 1999, Caddy and Cochrane 2001, Caddy and Regier 2002, Pauly *et* al. 2002, Link 2002, Barange 2003, Garcia *et al.* 2003).

The remainder of this chapter presents an ecosystem-based approach that represents fisheries systems as self-organizing, holarchic, open (SOHO) systems. This is done to emphasize the complexity facing post-1992 cod fisheries managers and to illustrate the new management challenges that are raised by ecosystem verses single species approaches to the cod fishery.

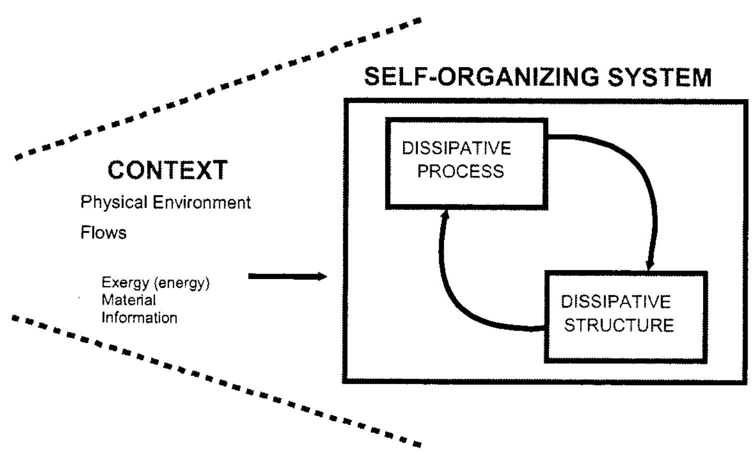
### 5.3 Coping With Complexity: Ecosystem Approaches and the Crisis of Controlling Fish Populations

> The implications of this argument are more easily grasped if we distinguish between two very different meanings of the word "manage." One...is synonymous with control. This idea refers to systems such as a factory production line...that can be fully understood and taken command of in their entirety...[T]he second meaning is best represented by our colleague Steve Rayner's Auntie Flo. Auntie Flo's husband passed away, and she herself was getting on in years. Living by herself, with little in the way of savings, she became a cause for concern to her relatives. "Don't worry about me," she told them brightly, "I'll manage!" Auntie Flo did not take complete control of anything. Rather, she coped successfully and effectively with a system that she well knew was, to a large and not entirely knowable extent, beyond her control... (Thompson and Trisoglio 1997:117-118).

SOHO systems (and other ecosystem-based heuristics) illustrate the need for new approaches to management focused on coping rather than the control and careful use orientation of single species population management (Kay *et al.* 1999, Boyle *et al.* 2001, Bavington and Kay 2003/2005—Figure 5.1). SOHO systems descriptions are useful in situations where there are high levels of uncertainty, conflict, and large decision stakes (Ravetz 1999). Many have argued that these situations call for a new type of science that moves beyond the expert-based, reductionist, mechanistic science of the Enlightenment and high modernism.

**Figure 5.1** Conceptual Model for SOHO Systems

The diagram below represents a conceptual model for self-organizing systems as dissipative process/structures. "Self-organizing dissipative processes emerge whenever sufficient exergy is available to support them. Dissipative processes restructure the available raw materials in order to dissipate the exergy. Through catalysis, the information present enables and promotes some processes to the disadvantage of others. The physical environment will favour certain processes. The interplay of these factors defines the context for (i.e. constraints) the set of processes which may emerge. Once a dissipative process emerges and becomes established it manifests itself as a structure. These structures provide a new context, nested within which new processes can emerge, which in turn beget new structures, nested within which...Thus a SOHO system emerges, a nested constellation of self-organizing dissipative process/structures organized about a particular set of sources of exergy, materials and information, embedded in a physical environment" (Kay *et al.* 1999:724). In a marine ecological setting examples of *structures* could include individuals of a particular species, stocks of fish or breeding populations, coral, eelgrass, etc. The ecological *processes* would take in reproduction, metabolism, primary productivity, etc. The *context* would be determined by the available set of nutrients and energy sources in the physical environment and the information would consist of the biodiversity (Kay *et al.* 1999).




As discussed in chapters two and three, Ravetz and Funtowitz (1999) propose "post-normal science" (PNS) for situations that lie outside the controlled environments of the laboratory where stakes are high, certainty is low, and the need for "extended facts" and an "extended peer community" beyond that of narrow disciplinary scientific expertise demand a focus on the quality of the scientific process as opposed to the singular expert drive for universal Truth (*see* Table 3.2 *on page 63*). Expressing similar concerns, Hengeveld and Walter (1999, 2000) criticize the "demographic paradigm" that forms the scientific foundation of population-based fisheries management. They argue that scientific paradigms and methods that rely on statistical techniques and demographic "laws" fail to take into account the experiences of organisms living in fluctuating, heterogeneous environments[10]. Hengeveld and Walter (1999) argue that demographers search for general ecological laws and quantifiable principles in isolation from real-world physio-chemical and biological contexts.

> Definition and quantification of the following features...forms the basis of demographic ecology research: mean population density, or population equilibrium, the type and degree of density dependence and the upper and lower levels around the equilibrium density as determined by other species, as well as by the carrying capacity of the environment they share. Such statistical attributes are idealistic in nature because it is assumed implicitly that they will impact the ecological performance and evolutionary trajectories of presently existing individuals. However, the deterministic nature of these statistical attributes and postulated population-level processes does not convincingly accommodate the variation readily observable in natural situations, and the population statistics represent nothing that can be experienced by the individual organisms themselves...Even though the ideals may be represented by statistical attributes, it is merely the incidental population consequences of individual-level processes that are actually quantified (Hengeveld and Walter 1999:149).

As an applied science involving high levels of uncertainty surrounding measurements, large decision stakes for the communities involved, and conflicts around how to proceed, fisheries science and management are good candidates for a post-normal science approach that does not rely on idealized demographic models such as those

[10] They argue that "a serious dislocation exists between demographic theory and ecologists' experience with organisms in natural situations" and that "many of the expectations generated by demographic models are frequently not observed in natural systems, or are not measurable there" (Hengeveld and Walter 1999:143).

deployed under population-based cod fisheries management. SOHO systems understanding is a post-normal approach to science that moves beyond equilibrium-based demographic theory by building on the tradition of von Bertalanffy's general systems theory (1950) and Koestler's notion of holons and holarchy (1978)[11]. SOHO systems approaches emphasize nested hierarchy theory, self-organization and the openness of social and ecological systems to energy, materials and information[12] (Kay *et al.* 1999). Applied to fisheries, SOHO systems models focus attention on the hierarchical nature of fisheries systems by considering issues of scale (temporal and spatial), system type (physical, biological, societal) and the bounding and nesting of fishing activities within these systems[13]. Additionally, SOHO systems models draw attention to the dissipative structures and processes that can evolve in marine ecosystems out of specific physical environments that provide high quality energy (exergy), material and information permitting the emergence of self-organization (Figure 5.1) (Kay and Schneider 1994, Kay *et al.* 1999)[14].

From the nested hierarchical perspective of SOHO systems modeling, marine ecosystems provide the context for the emergence of complex societal fishing systems, or fishing societies, which exhibit self-organizing dissipative structures and processes contingent on the extraction of structure or biomass from the marine ecological system

---

[11] A holon is a whole/part entity or system that exists contextually in a nested network of other holons forming a holonarchy (Kay *et al.* 1999). Russian dolls provide a good analogy for holonarchy, where each doll in the nested set represents a complete system that forms a context for, and is embedded within, the context of other dolls.

[12] The hierarchical nature of complex systems requires that they be studied from different types of perspectives and at different scales. With SOHO systems descriptions there is never only one correct perspective, rather a diversity of views are required for understanding (Boyle *et al.* 2001).

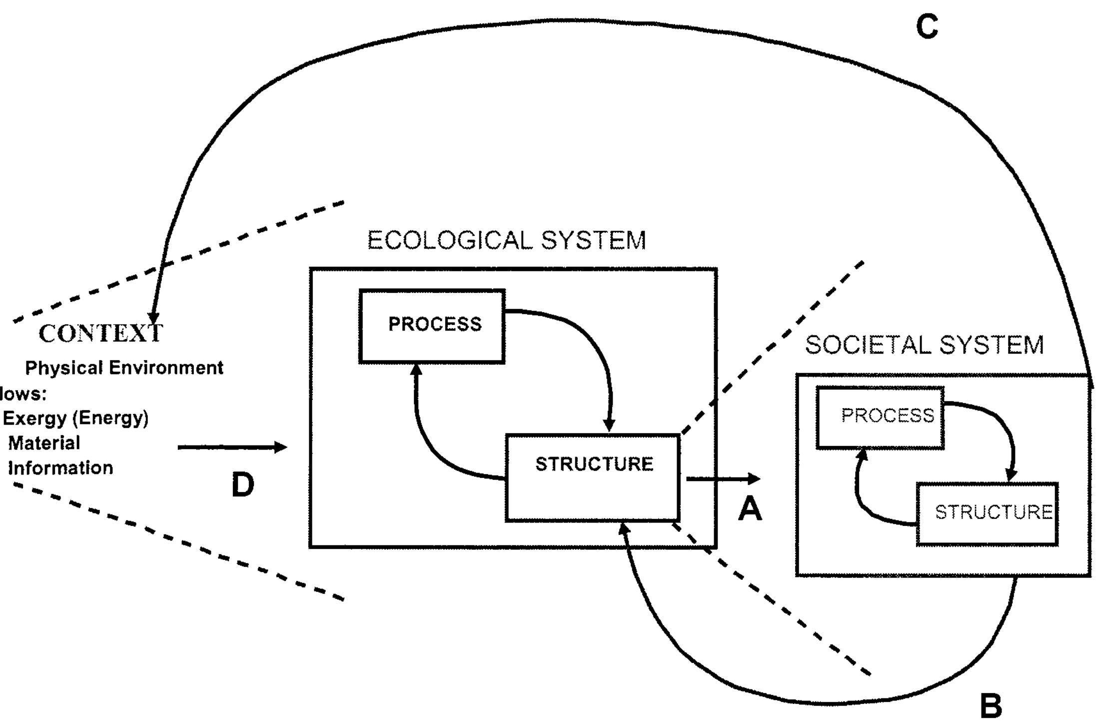
[13] While physical and biological systems often display hierarchical nesting, societal systems often involve tangled hierarchies that exhibit scale mismatch with respect to ecological hierarchies, structures and processes (Francis 2004).

[14] High quality energy is referred to as *exergy* and is a reflection of how organized or useful energy is with respect to its ability to do work (*see* Kay 1991, Kay and Schneider 1992, Kay *et al.* 1999).

(*see* Figure 5.2 *on page 141*). In addition to framing the nested hierarchical nature of fishing activities, SOHO systems models focus attention on the feedbacks that exist between fishing activities, ecological structure and the physical environmental context out of which both ecological and societal self-organizing systems emerge (Kay *et al.* 1999).

**Figure 5.2** SOHO Systems Model

This model is used to illustrate Newfoundland and Labrador fishing dynamics by focusing on the physical environmental context (D), the self-organizing structures and processes of the ecological and societal systems, feedbacks between them (B&C), and the transfer of ecological structure into the societal system (A).



SOHO fisheries systems can exist in a number of stable states around attractors[15] (sometimes referred to as ecological regimes), and can resist movement away from them (Kay *et al.* 1999). This resistance to change is accomplished by feedback loops in the SOHO system that serve to maintain the systems' current state, however, when critical thresholds are breached and the SOHO system moves beyond the domain of an attractor, system change tends to be rapid and catastrophic, flipping from one regime/attractor into a new one (Holling and Meffe 1996, Kay and Regier 1999, Kay *et al.* 1999, Boyle *et al.* 2001). Flips in aquatic systems have been observed in Lake Erie involving a benthic and pelagic attractor (Regier and Kay 1996, Kay and Regier 1999) and regime shifts have been postulated for marine systems including changes from ground-fish to crustacean regimes driven by modifications in water temperature and salinity in the Northwest Atlantic off Newfoundland and Labrador, Canada (Rose 2003) and others throughout the world's oceans (Steele 1998, Scheffer *et al.* 2001). The precise time when flips occur, the domain-space of the new attractor, and the exact state the system will change into are generally not predictable (Kay *et al.* 1999). This is because in any given SOHO fishery system there are often several possible system states (attractors/regimes). The state that the system arrives in is a function of its history and there is never a universally "correct" state for a system, in spite of the fact that there will be system states that are preferred by specific groups of people (Kay *et al.* 1999, Boyle *et al.* 2001, Wilson 2002).

The recognition that there is never a universally "correct" regime for an ecosystem increases the challenges and skills associated with fisheries management. Managing fish populations for maximum productivity, and fishing activities for

[15] "A SOHO system exhibits a set of behaviours which are coherent and organized, within limits. The nexus of this organization at any given time is referred to as an attractor" (Kay *et al.* 1999:725).

maximum sustainable or economic yield as postulated under demographically derived bio-economic models becomes extremely difficult, if not impossible. Uncertainty and the lack of objective universal truth means that there can no longer be a single expert derived answer, or easily reached consensus on management goals and techniques. Ecosystem-based fisheries management (EBFM) requires opening up managerial processes of goal formation, and it demands new skills on the part of managers. Fisheries managers must shift from giving expert advice on total allowable single species catch levels to facilitating diverse stakeholder participation, learning within the unknowable (Flood 1999), and negotiations to determine which self-organizing ecological regimes they should be attempting to influence[16]. Cod fishers in Newfoundland and Labrador, for example, have an interest in promoting ground fish regimes with healthy stocks of capelin, other cod prey, and low numbers of cod predators such as harp seals; while crab and shrimp harvesters depend on crustacean attractors with appropriate environmental and trophic dynamics to maintain their fishery (Gray 2000, Wilson 2002). The preferences of fishers and other marine stakeholders for particular marine regimes or attractors will be mediated by their values, perspectives, linkages to other systems, historical attachments, understanding, interests, power, influence, and a multitude of other factors. Market demand exerts a dominating influence on how self-organizing marine regime shifts are interpreted by fish harvesters and processors, while the direction of the regime change relative to trophic levels and biodiversity can alter how marine biologists interpret new system states, perceiving them either as signs of ecological

[16] This shift requires changes on the part of managers, institutions, the managed and all those with an interest in the ecosystem. In chapter six I will discuss these new challenges and managerial roles as they are playing out in the context of neo-liberal market managerialism in the Newfoundland and Labrador fishery.

recovery or further evidence of fishing down sequences (Pauly *et al.* 1998, Pauly and MacLean 2003, Bavington *et al.* 2004). How regime shifts and attractors are interpreted is influenced by power relationships and knowledge struggles located in particular histories, political, economic, social and ecological contexts.

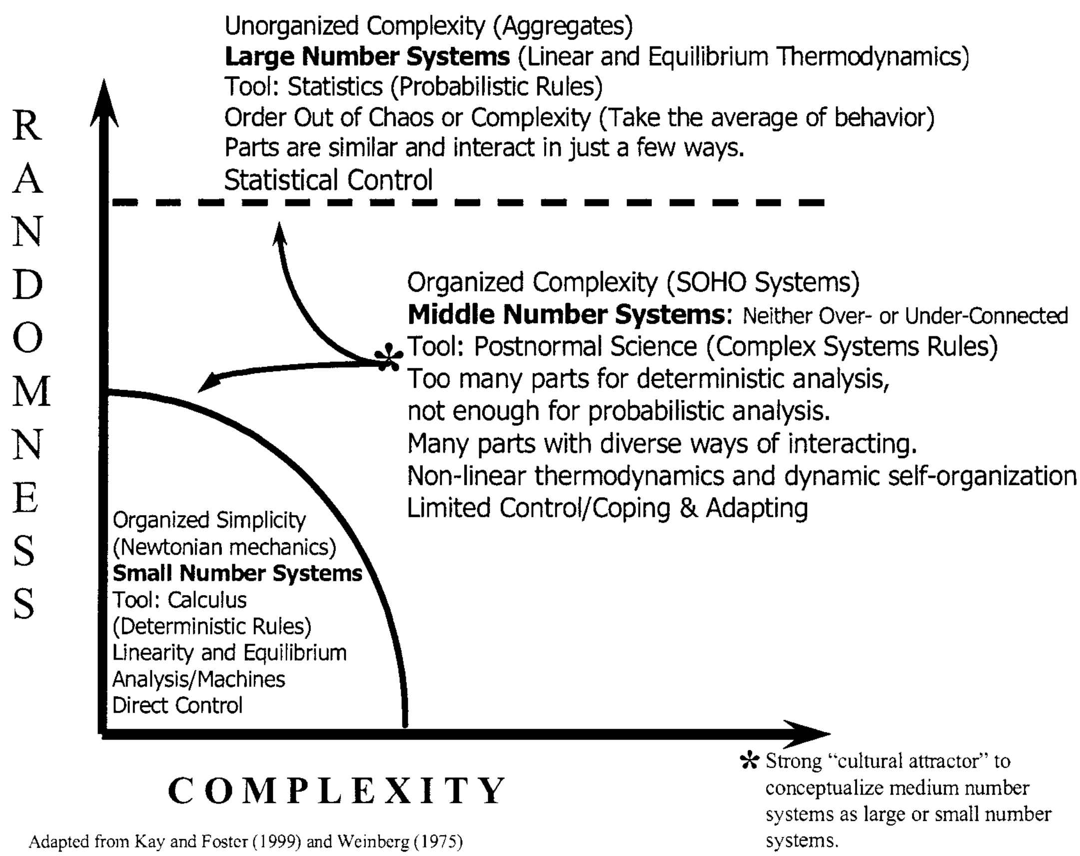
The SOHO systems model permits a new understanding of the complexity of fisheries systems and suggests a different role for science, monitoring and management. It removes the idea of an objective, context free assessment of changes in fisheries systems, and focuses on the importance of *who* is making monitoring and management decisions and *what* is motivating their preferences and perspectives. The hierarchical nature of SOHO fisheries systems must be understood through a consideration of issues involving system scale and type, and the bounding and nesting of the system that inevitably involves identifying "important" processes, structures, feedbacks and contexts (Boyle *et al.* 2001). What constitutes an "important" process, structure, feedback or context will be characterized by the position of the fishery system observer and can never capture everything—"importance" will always involve values, interests and disproportionate power relationships that require multiple observers to capture a diversity of perspectives on the SOHO fishery system and introduces the contradictory challenge of attempting to cope with *and* also facilitate conflicting and often incommensurable perspectives (Kay *et al.* 1999, Gray 2002, Cooke and Kothari 2002)[17].

While *possibilities* of future system states can be offered by experts, exact *predictions* of fishery system dynamics are not possible when fisheries systems are understood with SOHO systems models. This is because self-organizing systems display

[17] The new forms of management that have accompanied this participatory process will be discussed with reference to the Newfoundland cod fishery in chapter six.

"middle number" behaviour[18] that can only be described and understood by exploring *possible* attractors accessible to the system, the feedbacks that *may* maintain the system at the attractors, the external influences which *could* define the context for a specific attractor (or regime), and the conditions under which flips between attractors (or regimes) are *likely* (Kay *et al.* 1999, Kay and Foster 1999, Boyle *et al.* 2001). In the "middle number systems" that characterize most of the environmental and social issues associated with marine fisheries today, the assumptions of large number systems where population statistics can be applied, and of small number systems where deterministic quantitative methods such as calculus can be used, are of limited applicability (*See* Figure 5.3).

**Figure 5.3** Large, Middle and Small Number Systems




Adapted from Kay and Foster (1999) and Weinberg (1975)

---

[18] *See* Figure 5.3 for an explanation of "middle number" systems.

Fisheries issues exhibit complex system dynamics that contain too many diverse elements for deterministic analysis and not enough elements of identical and average type to apply statistics (Weinberg 1975, Kay and Foster 1999).

The decision stakes surrounding fisheries issues are often extremely high, with associated levels of uncertainty that move beyond the scope of normal science (Funtowicz and Ravetz 1993). Single species management of fisheries systems has tended to focus on attempts to absorb complexity and reduce uncertainty—messy problems are recast as being amenable to direct or statistical control (Ludwig *et al.* 1993, Torgerson 1999). From the perspective of EBFM this practice is inappropriate and leads to management failures and surprises because fishery systems are complex (Rosen 2000, Ottino 2004)[19]. Fishery systems involve many different types of interacting systems (societal, biological, physical), displaying non-linear dynamics, operating at a variety of nested and tangled temporal and spatial scales with multiple possible attractors and self-organizing regimes, irreducible uncertainties associated with their observation, and a variety of legitimate perspectives on their description (*see* Table 5.3 *see page 147*).

[19] "If a system – despite the fact that it may consist of a huge number of components – can be given a complete description in terms of its individual constituents, such a system is merely *complicated.* Things like jumbo jets or computers are complicated. In a *complex* system, on the other hand, the interaction among constituents of the system, and the interaction between the system and its environment, are of such a nature that the system as a whole cannot be fully understood simply by analyzing its components. Moreover, these relationships are not fixed, but shift and change, often as a result of self-organization" (Cilliers 1998:viii). In a similar vein Rosen (2000:44) defines complex systems as those which can not be quantitatively modeled: "A system is complex if it has noncomputable models. This characterization has nothing to do with more complication, or with counting of parts or interactions…" (Rosen 2000:44).

**Table 5.3** Properties of complex systems to keep in mind when thinking about SOHO fisheries system descriptions (Adapted from Kay *et al.* 1999:727 and Boyle *et al.* 2001).

| | |
|---|---|
| **Non-linear** | Behave as a whole, a fishery *system*. Cannot be understood by taking them apart into pieces that can be added or multiplied together. |
| **Hierarchical** | Are *holarchically nested*. The fishery system is nested within a system and is made up of other systems. The 'control' exercised by a holon of a specific level always involves a balance of internal or self-control and external, shared, reciprocating controls involving other holons in a mutual causal way that transcends the old selfish-alturistic polarizing designations. Such nesting cannot be understood by focusing on one hierarchical level (holon) alone. Understanding comes from multiple perspectives of different *types* and *scales*. |
| **Internal Causality** | Non-Newtonian, not a mechanism, but rather is *self-organizing*. Characterized by goals, positive and negative feedback, autocatalysis, emergent properties, and surprise. |
| **Window of Vitality** | SOHO systems must have enough complexity but not too much. There is a range within which self-organization can occur. Complex systems strive for *optimum*, not minimum or maximum conditions. |
| **Non-Equilibrium/ Dynamic Stability** | There may *not* exist equilibrium points for the fishery system, however, fishery systems may be characterized by dynamic flux and change within the constraints imposed by the physical environmental context. |
| **Multiple Steady States/Regimes** | There is *not* necessarily a unique preferred system state in a given fishery. *Multiple attractors* can be possible in a fishery and the current system state may be as much a function of historical accidents as anything else. For example, regime shifts in fishery systems may be a result of the combination of particular fishing pressures, changes in the physical context (such as ocean currents, water temperature and salinity), and shifting ecological structures and dynamics. There may be multiple regimes which are valued differently by different actors in the system. |
| **Catastrophic Behaviour** | The norm.<br>Bifurcations: moments of unpredictable behaviour.<br>Flips: sudden discontinuous, rapid change.<br>Holling four-box cycle/shifting steady state mosaic. |
| **Chaotic Behaviour** | Our ability to predict and forecast fishery systems is always limited. For example, with weather forecasts it is between 5 and 10 days regardless of how sophisticated the computers are or how much information is available, due to the sensitivity to measurement conditions and unavoidable measurement errors. Stock assessments therefore cannot be used for anything like future predictions over multiple years and managers need to establish safe biological limits with reference to particular regimes or attractors as opposed to precise total allowable catch (TAC) levels. |

Ecosystem approaches to fisheries such as the SOHO systems model raise different questions, data needs, monitoring requirements and managerial outlook to those offered by the reductive single species approach (Slocombe 1993, 1998, Kay *et al.* 1999, Link 2002). SOHO systems descriptions focus managers and interested stakeholders on a series of new questions that go beyond the traditional focus on annual single species stock assessments, total allowable catch levels, and quota allocation in fisheries science monitoring and management. The new questions focus on the ecological and physical contexts within which fishing takes place and the feedbacks within and between societal systems, ecological systems and the physical environmental context (*see* Table 5.4 *below* and Figure 5.2 *on page 141*). Rather than focusing on managing fish populations and environmental contexts directly, the focus is on explicitly managing human interactions with the biophysical systems that make up the ecological context and structures desired by particular social systems.

**Table 5.4** New questions which flow from the SOHO ecosystem heuristic applied to fisheries.

| |
|---|
| 1) What are the elements (structures and processes) of the societal fishing system that you wish to maintain? |
| 2) What is the ecological context necessary to maintain the processes and structures of the societal fishing system? (Figure 5.3-A) |
| 3) What are the ecological structures and processes that provide the context for the societal fishing system? |
| 4) What is the physical environmental context necessary to maintain the processes and structures of the ecological system? (Figure 5.3-D) |
| 5) What structural changes does the societal fishing system make to the ecological system? (Figure 5.3-B) |
| 6) How does the societal system alter the physical environmental context? (Figure 5.3-C) |

The complexity of fished ecosystems and the inherent limits on accurately forecasting the consequences of fishing have led the Food and Agriculture Organization

(FAO) and national fisheries departments to advocate application of the precautionary principle to fisheries management (FAO 1995, MacGarvin 2002). The precautionary principle has introduced an "official element of uncertainty into stock assessments where previously there had officially been certainty" and has shifted the emphasis in fisheries management away from optimizing production toward conservation and risk management initiatives where "the most important outcome to be predicted… [is] not catch but spawning biomass" (Gray 2002:3). This has resulted in fishery management actions that are more tightly defined in space and time "than would be wished for by…nourishers of the modernistic control ideal" (Kwa 1994:92).

Incorporation of the precautionary principle and spawning biomass monitoring into fisheries management has not, however, fundamentally altered the quantitative foundation of population-based fisheries science nor ongoing dreams of the modern control ideal. While fisheries managers and their institutions are increasingly acknowledging scientific uncertainty and complexity—"because the environment and the organisms inhabiting it are both essentially non-stationary in time and space"—the dominant response "to this changed perception…has been various *ad hoc* modifications to demographic ecological theory, and the belief that such adjustments are adequately coping with the changed perceptions" (Hengeveld and Walter 2000:16-17). DFO has adopted a weak version of the precautionary principle, interpreting it as a utilitarian cost-benefit analysis tool that effectively reverses the burden of proof requirement embedded in the principle (Garcia 1994, FAO 1995, DFO 2002a)[20].

[20] While the precautionary *principle* has been adopted by a number of international and national fisheries management organizations, it has mainly been implemented as the precautionary *approach*. (DFO 2001a/2002a). The precautionary *principle* places the burden of proof on development proponents to prove that any harm resulting from their operations will be reversible, placing the emphasis on proponents to

### 5.4 Socio-Ecological SOHO Description of the Newfoundland and Labrador Cod Fishery: From Cod Abundance and Collapse to the Crustacean Regime

In spite of several expert-based cod fisheries reports and inquiries looking into the state of the cod fishing industry and scientific stock assessments throughout the 80's and early 90s (Kirby 1983, Keats *et al.* 1986, Harris 1990, Finlayson 1994), quotas for Northern cod remained high up until 1992 when the Canadian offshore trawler fleet was unable to find cod to catch on the offshore banks and a stock collapse crisis was declared (Steele *et al.* 1992, Walters and Maguire 1996). A belief that fishing mortality was the only relevant variable determining stock size, and the associated assumptions that environmental variables remained relatively constant and favourable to cod population growth, and that fishing did not significantly alter the natural growth rates and productive dynamics of cod populations, are now believed to have permitted managerial confidence that controlling fishing effort would allow for accurate quantitative predictions of stock structure (Rice *et al.* 2003, Rose 2003).

Operating on the assumptions of single species fisheries management, the initial cod population growth estimates claimed that cod would recover quickly (within 2-5 years) with the cessation of directed commercial fishing (Rice *et al.* 2003, Rose 2003,

---

develop *safefail* systems where unexpected outcomes will not lead to catastrophic ecological effects (Holling 1976). Fisheries managers are not to delay cost effective conservation measures simply because they lack definitive scientific evidence or undisputed data on damaging fishing practices and other economic activities in the marine environment. The precautionary *approach* places the burden of proof on regulators to calculate cost benefit analyses illustrating that restrictions on fishing and other marine development activities do not, on balance, irrevocably or unnecessarily harm the economy. While the precautionary *principle* implies a deontological ethical framework that places strict limits on human activity, the subtle shift in terminology from the precautionary principle to the *approach,* promotes a permissive utilitarian ethical stance focused on maximizing the greatest good for the greatest number of human or corporate economic actors (VanDeVeer and Pierce 1998, Coward *et al.* 2000). DFO's precautionary *approach* provides the very ethical framework and burden of proof requirement which the precautionary *principle* was designed to avoid and eliminate.

Bavington *et al.* 2004)[21]. The optimistic belief in rapid recovery flowed from assumptions central to single species stock assessment and population-based fisheries management models. Predictions of rapid cod recovery appeared rational and legitimate because the ecological, environmental and behavioural conditions associated with cod productivity were assumed to be similar to the conditions that existed during the original rebuilding effort in the late 1970s for which data were available (Finlayson 1994, MacGarvin 2002). In addition, legal by-catch, illegal fishing, and scientific survey fisheries were assumed to be inconsequential for cod population rebuilding (Rice *et al.* 2003, Rose 2003).

After more than a decade since the moratorium, single species management assumptions applied to the Northern cod appear to have been overly optimistic and simplistic (Rose 2003). Since 1992, forensic fisheries science has found that cod have failed to recover across their range and their spawning biomass has been all but eliminated—having declined 99.9% from levels measured in the 1960s (Hutchings 2004). Other ground fish stocks have also collapsed, resulting in the complete closure of the cod fishery and scientific recommendation that Northern cod be listed as an endangered species (COSEWIC 2003). Increasingly, fisheries scientists argue that system wide regime shifts and fishing down sequences have occurred in the Northwestern Atlantic as higher trophic level ground fish species decline and jellyfish, scavenger species (e.g. sculpins), crustacean populations (e.g. snow crab, *Chionocetes opilio* and northern shrimp, *Pandalus borealis*) expand (Pauly and Maclean 2003, Rose 2003). The fishing

[21] As Finlayson (1994) notes in a study of DFO's cod fisheries management, single species fisheries models contain large amounts of interpretive flexibility. There were large political and institutional incentives within DFO for scientists to downplay the uncertainty and complexity of cod stock assessments and the time that would be required for cod stock recovery (Finlayson 1994, MacGarvin 2002).

industry, the provincial Department of Fisheries and Aquaculture (DFA) and rural development boards are responding to these regime shifts by focusing harvesting effort on crustaceans (northern shrimp and snow crab) and developing harvesting strategies for "underutilized" species such as sea urchins, jelly fish and sculpins (Curtis 2002, Harte 2002).

Fisheries scientists observe that cod are maturing younger, experience high mortalities at age five for unknown reasons, and that female cod often fail to spawn annually as predicted (Rose 2003, Rowe and Hutchings 2004). Inshore cod populations have also experienced sudden mortalities due to super cooling events in Smith's Sound on the east coast of the island for unknown reasons (Lilly *et al.* 2004). Oceanographers emphasize the cyclical nature of environmental fluctuations that are postulated to have bottom-up forcing implications on fish stocks including the Northern cod (Klyashtorin 2001, Drinkwater 2002, Barange *et al.* 2003). Each of these new pieces of scientific information and interpretations undermines the equilibrium assumptions that permit effective population-based fisheries management. New scientific knowledge about cod and the recognition of large zones of ignorance around its behaviour creates a general perception, and increasing reality, of unmanageable complexity, confusion and conflict around the appropriate direction for future cod fisheries management.

The uncertainty, ignorance, complexity and conflict associated with the collapse of the Newfoundland and Labrador Northern cod fishery provides a relevant case study to apply the SOHO systems model to work through some of the structural changes that have occurred in biophysical and socio-economic systems, and the energy, material and informational flows and feedbacks that currently exist within and among them. It also provides a good example of the reasons behind calls for shifts from single species to ecosystem-based fisheries management. In addition to building a more realistic picture of the dynamics of exploited fish populations (Link 2002), proponents argue that ecosystem models of the Newfoundland and Labrador fishery highlight the inter-connections that exist between social and ecological systems and the complexities and challenges associated with attempts at their management (Bavington and Kay 2003).

### 5.5 The Transfer of Marine Ecological Structure into the Societal System of Newfoundland and Labrador

The socio-economic and cultural system of Newfoundland and Labrador has historically been, and continues to be, extremely dependent on extracting marine ecological structure through fishing (Figure 5.2-A *on page 141*). As discussed in the introduction, the cod fishery was the reason for European interest in the island and England, France, Spain and the Basques vied for colonial control of the rich fishing grounds from the time of official European "discovery" in 1497 (Innis 1954)[22].

In the SOHO systems model of the Newfoundland and Labrador fishery (*represented in* Figure 5.2) the arrow marked A represents the movement of ecological structure (codfish) into the societal system. The abundance of codfish and the belief in its manageability was predicated on favourable ecological structures and processes comprising a ground fish dominated regime with capelin forming a critical prey source for cod. Half of the ecological structure (cod biomass) removed from the ocean adjacent to Newfoundland and Labrador was fished seasonally over a 400 year period from 1500-

[22] There were species other than cod that were harvested in Newfoundland and Labrador and some were extirpated by the turn of the $20^{th}$ century. These included the Great Auk, marine mammals, sea birds and several other terrestrial species (Pauly and Maclean 2003, Rose 2003).

1900 using pre-industrial fishing technology, primarily baited hooks on hand lines. This period experienced severe fluctuations in landings that had to be accepted and adapted to until the birth of fisheries management when fluctuations were targeted for elimination to permit modernization, industrialization and rationalization of cod fishing and Newfoundland and Labrador's fishing society.

With industrialization and rationalization of fishing and processing technologies, 50 million tons of codfish were rapidly removed from the Newfoundland and Labrador ecosystem from 1900-1993—an amount of cod that had taken 400 years to catch before the mechanization of fishing. Fisheries management developed in the historically unprecedented context of industrialization when year-round fishing activities took place on the offshore banks, often during spawning or on pre-spawning aggregations (Steele *et al.* 1992, Rose 2003) and bait, roe and reduction (fish meal) fisheries targeted squid, capelin and other prey species of cod. Industrialization led to a spatial and temporal scaling up of the fishery and initiated a fishing down trajectory resulting in the loss of large breeding "mother" fish and decreases in their size-at-age (Pauly and Maclean 2003, Bavington *et al.* 2004). Industrialization and management of the fishery were also associated with Newfoundland and Labrador joining Canada and a general modernization of the societal system as described in chapter four. This modernization altered social life, political institutions and conceptions of nature shifting the peasant fisher-merchant society, based on the household production of dried salt cod, into a modern market society with wage labour and factory production of frozen seafood products in fish plants (Wright 2001, Ommer 2002).

Since 1993, the species composition and the annual biomass of landings extracted from the ecological system have changed dramatically and this has had profound effects on the processes and structures of the societal system (Bavington *et al.* 2004). The biomass of all fish landings in the Newfoundland and Labrador fishery has been cut roughly in half compared to the average landings in the last decades of the pre-1992 period, and the main composition of the landings has shifted from ground fish (northern cod) to crustaceans (northern shrimp and snow crab) (*see* Table 5.5 *on page 156*).

Counter-intuitively from the perspective of fishing down theory, but in total keeping with capitalist market logic, the high market value of the lower trophic level crustaceans (mainly snow crab) has resulted in an extremely profitable fishery, exceeding the historic cod fishery to become the most profitable in Newfoundland and Labrador's history. The shift from a ground fishery to one focused on crustaceans has altered the structure of the fishing industry, rural fishing communities, and the societal processes that rely on and help to sustain it (Neis *et al.* 2001).

The crustacean fishery involves fewer people, and with fewer fishers capturing a higher value product, wealth has become increasingly concentrated within fishing communities and regions of the province where crab licenses are plentiful versus those areas where they are scarce (Bavington *et al.* 2004 and *see* Table 5.5 *on page 156*). Processor profit margins and market demand for crab have allowed some fishers to finance expensive upgrades on their boats (increasing the overall fishing capacity of the fleet, especially the 35-65 foot boats) through "trust" agreements with fish processors, who gain guaranteed access to the profitable crab resource without having to compete with other processing companies (FFAW 2004). This change has increased fishing capacity and undermined DFO's fleet separation policy encouraging corporate vertical integration of the industry by allowing processors to obtain proxy ownership of crab licences that are supposedly held by small, owner-operated harvesting enterprises (FFAW 2004).

**Table 5.5** Data on landings, number of fishing vessels and licenses between 1991 (one year before the cod moratorium) and 2001. Data show that full time licensed fishers dropped from ~ 14,000 in 1991 to 4000 in 2001; Fishing vessels dropped from ~ 15,000 in 1991 to 9,000 in 2001; Species landings decreased from ~ 425,000 MT in 1991 to 270,000 MT in 2001; and the landed value before processing of all species climbed from ~ $260 million in 1991 to $520 million in 2001. Data on separate ground fish, crab and shrimp licences were only available for 1991 and 2000 (DFO 2004a).

| | **1991** | **2001** |
|---|---|---|
| **Landings (All Spp.) in Metric Tons** | 424,808 MT | 267,959 MT |
| **Landed Value Before Processing** | $261,973,000 | $519,027,000 |
| **Total # of fishing licences** | 24,409 | 14,385 |
| **Core/Full Time Licences** | 14,184 | 4,057 |
| **Non-Core/Part Time Licences** | 10,225 | 10,328 |
| **Crew Members** | N/A (Category did not exist) | 4,500 |
| | **1991** | **2000** |
| **Cod Landings (MT)/ # of groundfish licences** | 160,396 MT / 9447 | 23,774 MT / 5039 |
| **Crab Landings (MT) / # of licences** | 16,149 MT / 736 | 58,107 MT / 779 |
| **Shrimp Landings (MT)/ # of licences** | 21,729 MT/ 57 | 75,871 MT / 420 |
| **Total # of Licenced Fishing Vessels** | 14,905 | 8712 |
| **Inshore >35 Ft. Vessels** | 13,678 | 7693 |
| **Nearshore 35-65 Ft. Vessels** | 1,143 | 982 |
| **Midshore 65-100 Ft. Vessels** | 8 | 11 |
| **Offshore <100 Ft. Vessels** | 76 | 26 |

In addition, there are fewer processing jobs associated with crustaceans due to the market preference for unprocessed snow crab-in-the-shell leading to disproportionate impacts on women who are the main workers in the processing sector (Neis *et al.* 2001, Bavington *et al.* 2004). Processing workers have also been exposed to new occupational hazards, such as crab asthma, associated with handling large amounts of crab (Neis *et al.*

2001). The reassignment of shrimp quotas to the province of Prince Edward Island (PEI) in recent years may also contribute to an increase in the number of seasonal migrant plant workers from rural Newfoundland going to that province. The change in landings resulted in fishers having to travel longer distances to catch their quotas and pressure to expand fishing effort and the size of boats resulting in a greater number of marine accidents (Wiseman *et al.* 2001). The change in the spatial distribution of the fishery and concerns with managing crab and shrimp stocks has led DFO to require all vessels over 35 feet to carry a GPS satellite tracking device that can send real-time position data to the Department during the fishing season[23].

Since 1993, corporate fish processing companies such as Fisheries Products International (FPI) are increasingly sourcing product globally rather than locally as one of a number of strategies international seafood corporations are using to cope with uncertainties in quantity, timing and quality of marine resource supplies (*see* Table 5.6 *on page 158*). Seafood corporations focus on value-added processing that combines wild seafood caught off Newfoundland and Labrador with seafood sourced internationally from both wild and cultured fisheries (Rowe 2004ab). FPI, one of the largest seafood corporations in North America, operates plants in Newfoundland that import farmed salmon from Chile, cod captured in the Barents sea and pre-processed in China, and farmed Tilapia for use in value-added products mainly destined for the restaurant market in the United States (Rowe 2004ab). FPI sells primarily to large restaurant chains in the United States, and produces premium value-added brands such as President's Choice™ and Costco™ in Canada (Rowe 2004ab).

---

[23] This requirement was introduced for the 2004 fishing season. The cost of the "black box" transmitters required by DFO range from $1000-$5000 (NTV 2004).

**Table 5.6** Types of uncertainty faced by global seafood processing corporations and the managerial coping strategies they use to address them (Adapted from Ottesen and Gronhaug 2003:368).

| **TYPE OF UNCERTAINTY** | **Input focused coping** | **Coping through transformation of production process** | **Output focused coping** |
|---|---|---|---|
| **Quantity of Supply** | - Direct or proxy ownership of vessels<br>- Loans to fishers<br>- Anticipatory marketing tactics<br>- Developing a portfolio of suppliers<br>- Using price mechanisms to increase supplies | - Developing high production capacity<br>- Financial slack<br>- Stockpiling of raw materials | - Educating, branding and providing info. about seafood supplies to customers<br>- Avoiding long term contracts with buyers |
| **Time of Supply** | - Direct or proxy ownership of vessels<br>- Developing a portfolio of suppliers | - Stockpiling of raw materials | - Educating, branding and providing info. about seafood supplies to customers<br>- Avoiding long term contracts with buyers |
| **Quality, Size and Type of Marine Species** | - A focus on specific vessels and gear types<br>- Prices to attract and educate specific suppliers | - Developing a diversity of production options through mechanization and retraining human resources<br>- Sorting and grading | - A diverse and flexible product mix with a focus on value-adding (not necessarily in the same physical factory but within the overall corporation)<br>- Selecting and developing niche markets and the "right" customers for particular products |

The switch to value-added processing, product diversification and the combination of multiple sources and types of fish from around the world resulted in FPI becoming profitable in the midst of the cod moratorium after years of financial trouble and government subsidies. FPI's seafood production is increasingly decoupled from dependence on raw material captured or cultivated in Newfoundland and Labrador. The company's de-linkage from exclusive reliance on local raw material and dependence on the US market has, however, exposed the corporation, and the Newfoundland and Labrador fishing industry in general, to risks associated with American currency fluctuations. A strong US dollar increases export profits and demand for Newfoundland

and Labrador crab, shrimp, and other processed seafood products while a falling US dollar has the opposite effect (Rowe 2004ab).

Changes in price and market demand (consumer demand is stronger for crustaceans and they fetch higher profit margins per pound than ground fish) and the relative abundance of crustaceans compared with ground fish species in Newfoundland and Labrador's current ecological system have resulted in complex dynamics within the post-1992 Newfoundland and Labrador societal fishing system. The gradual replacement of the resilient, pre-modern, low-profit, labour intensive inshore cod fishing society with a highly profitable, less resilient, modern, crustacean-based market society raises social and ecological sustainability questions.

The present societal system is extremely reliant on harvesting a low trophic level species (snow crab versus northern cod), employing relatively few fishers and processing workers (whose corporate customers and employers are tied into a global capitalist economic system heavily dependent on continuing U.S. consumer demand), high crab prices and the abundance of snow crab in the ecosystem. There are signs that snow crab populations are declining as catch-per-unit-effort and overall fishing capacity has declined in recent years and quotas have been cut in some areas, most notably off the southeast coast of Labrador (Bavington *et al.* 2004). Snow crab are still managed using a single species population quota model, catch-per-unit-effort information, and index fishing data collected by selected commercial crab fishers to complement DFO's annual research survey trawl (Anderson 2004). Because of their relative abundance and favourable environmental conditions, managers believe that single species demographic models are appropriate for snow crab; however some fishermen and women are already raising warnings that the models do not reflect their experiences on the water. Ecosystem approaches to the Newfoundland and Labrador fishery focus on the feedbacks that exist between the societal system, the ecosystem and the broader physical environmental context to gain a better understanding of the vulnerabilities and options for managerial intervention and action. These feedbacks will now be examined.

### 5.6 Feedbacks from the Societal to the Ecological System

Feedback loops represented in Figure 5.2-B (*on page 141*) can help to frame understanding of fisheries systems as complex socio-ecosystems, drawing attention to interactions between societal, ecological and physical systems. The SOHO systems model represented in Figure 5.2 draws attention to the ecological and physical systems that form the contexts for societal fishing systems and the relationships that exist between all three.

When trying to understand relationships in the Newfoundland and Labrador fishery, ecosystem-based fisheries management emphasizes the importance of including the overall impact fishing activities have on ecological systems. Arrow B in Figure 5.2 can be used to represent the total amount of ecological structure (species) removed from the ecological system or killed through fishing practices. These structures (species) will exceed the biomass of fish landings because ecological structure (overall biomass and species composition) can be disturbed or destroyed through by-catch, discards, and high-grading with impacts on marine mammals, fish, sea birds, and other marine species critical for ecological integrity and health. Ongoing fisheries deploying non-selective gears have resulted in high levels of unintended cod by-catch and some intentional targeting of cod up to legal by-catch landing limits (Rice *et al.* 2003, Winsor 2004, Winsor and Bavington 2004).

Marine fishing practices have also been shown to influence population level genetic composition, which ecologists argue can act as an artificial selection agent (Policansky 1993, Ernande *et al.* 2002). Noise produced by sonar, boat engines, and underwater seismic testing for petrochemical deposits can also affect fish behaviour, including mating rituals, population dynamics and broader ecological structures (Popper 2003, Rowe and Hutchings 2004). Shifts to crustacean fisheries, especially the shrimp fishery, have been associated with high levels of by-catch due to the trawling gear used. Recent studies of the crab fishery have also shown high mortality rates associated with throwing back juvenile crab that are caught in pots and pulled to the surface. The high mortality is thought to be due to damage inflicted to immature and soft shell crab during handling and increased predation pressures after release (Grant 2004). Structural changes to marine ecosystems induced by fishing gears such as otter trawls have resulted in claims from crab fishers that shrimp trawling damages the bodies and habitat of snow crab leading to increased incidents of soft shell, diseases, and physical harm to legs and the carapace. Additional structural changes could be highlighted in relation to fishing and other human activities conducted in the marine environment. Ecosystem approaches help to provide a conceptual framework to think through these structural changes and the feedback loops from the societal system that co-produce them and which may require management.

Structural changes in the ecological system feed back into ecological processes causing alterations which in turn feed back into ecological structures, often in unpredictable ways. The ecosystem approach to fisheries management promotes thinking through these feedbacks (Figure 5.2-B), and facilitating the participation of a group of diverse stakeholders with knowledge of them to help managers integrate knowledge from a diversity of observers, identify knowledge gaps, and assess the overall impact of harvesting technologies critical for the application of the precautionary principle in fisheries management (FAO 1995, DFO 2002a/2003a, Garcia *et al.* 2003). However, the recognition of these feedbacks significantly increases the challenges associated with, and the scope of, fisheries management. The focus shifts from single species fish populations and fishing mortalities associated with them to a broader range of human activities requiring control and careful use as well as environmental variables requiring ongoing monitoring, coping, and active adaptation.

In addition to feedbacks from fishing activities, the SOHO ecosystem model (Figure 5.2) can be used to think through the connections between other societal activities and ecological systems. As mentioned previously, exploratory seismic testing for petroleum resources and oil pollution at sea can cause increased mortality of larval fish, changes in the behaviour of marine organisms, seabird kills and additional interactions that alter ecological structures and processes. These changes in the ecological system ultimately loop back to affect what ecological structures are available for societal fishing systems (Figure 5.2-A *on page 141*), and the changes induced in ecological systems can affect societal systems that are spatially and temporally separated from the societal system that initiated the activity. The spatial and temporal separation of feedbacks (Figure 5.2-B) from the changes induced in the ecological structure available for a specific societal fishing system (Figure 5.2-A) are especially relevant to think through as capitalist economies become more globally integrated, industrial fishing and aquaculture expands, and human systems enhance their feedbacks onto the physical environmental context over increasing spatial and temporal scales (Figure 5.2-C *on page 141*). Ecosystem-based fisheries management draws attention to all of these human activities and targets them for management.

### 5.7 Feedbacks from the Societal System to the Physical Environmental Context

Feedback C in Figure 5.2 can be used to think through the relationships between activities in the societal system and the physical environment. From the SOHO ecosystem perspective, the physical environmental context shapes the self-organization that is expressed in ecological processes and structures by determining the available energy, material and information (Kay *et al.* 1999). Temperature changes (especially those associated with the North Atlantic Oscillation, the Labrador Current and the Gulf Stream) and other dynamic so-called "bottom-up" processes, such as relative amounts of precipitation, salinity, nutrients, genetic information, and introductions of ice and fresh water run off into marine ecosystems can influence spawning success, recruitment, migration and other behavioural attributes of species that are of direct interest to the societal system and those that form important indirect trophic interactions with commercially relevant species (Barange *et al.* 2003, Rose 2003, Sharpe 2004). In addition to natural cycles and dynamics, human activities in the societal system can feed back onto the physical environment (Figure 5.2-C) that comprises the context for a particular ecological system, and changes in the physical environment can cascade to affect ecological structures available to the societal system leading to changes in societal structures and processes (Steele 1998, Kay and Regier 1999, Scheffer *et al.* 2001). There are high levels of uncertainty and complexity associated with the identification and prediction of these feedbacks, ecosystem-based fisheries management aims to produce an integrative picture or narrative of the general trends, possible relationships, cascades, and results of current feedbacks and interrelationships.

Ecosystem-based perspectives, like the SOHO model, increase the scale and scope of managerially relevant structures and processes beyond single species fish populations and fishing mortality. In most cases, the natural and human induced feedbacks to the biophysical environmental context are hard to separate out causally and are beyond the control of managers which leads to calls for coping and adaptive stances as is clearly evident in climate change adaptation and management research (NRC 2003). From the perspective of budget-restrained fisheries managers the challenges associated with EBFM are often overwhelming and require inter-agency co-operation and increased participation by marine users willing to take on individual responsibility for fisheries management.

Feedback loops from the societal system to the physical environment (Figure 5.2-C *on page 141*) alter the context for the whole marine ecological system. These feedbacks may include: human-induced climate change, damming projects that affect the amount and temperature of fresh water and nutrients entering the marine ecosystem[24], and many others such as intensive industrial aquaculture which can introduce (or remove, in the case of bivalves) large amounts of energy and materials (nutrients, therapeutics and

---

[24] For example, the Churchill Falls Hydroelectric dam in Labrador may have nutrient, water temperature, and salinity effects on Groswater Bay in Labrador. These physio-chemical changes brought on by the dam are thought to have affected the productivity of cod stocks and the ecological integrity of the southeastern Labrador coastal zone and offshore continental shelf ecosystem (Wroblewski 2003).

other chemicals used on the farm) and non-native behaviours and genetic information through escapees (Bavington 2000/2001, Pauly *et al.* 2001). Fishing practices can also feedback to influence the physical environment and therefore the ecological context. Structural changes induced by fishing gears such as otter trawls disturb ocean habitat (Walting and Norse 1998) and have recently resulted in legal action against the government of Canada by environmental groups focused on the risks to demersal fish habitat associated with this type of deleterious feedback on Nova Scotia's Georges Bank (Winsor 2004, Ecology Action Centre 2004).

Many more perspectives on the interactions between, and internal dynamics of, the hierarchically nested physical context, ecological system and societal systems (Figure 5.2 *on page 141*) of the Newfoundland and Labrador fishery could be offered.[25] The SOHO systems model places the context, various systems, and their feedbacks into a hierarchy of holons to conceptualize the scalar dynamics that exist in complex SOHO fishing systems. However, while Figure 5.2 illustrates a model that helps identify and think through feedback loops, it does not necessarily illustrate actual hierarchical nesting involved in specific socio-ecological systems. Institutional hierarchies, power dynamics and boundaries often do not reflect biophysical boundaries, processes and structures resulting in scale mismatch issues and tangled hierarchies.

From the perspective of ecosystem-based fisheries management it is crucial that scale and cross scale issues and system types are taken into consideration when thinking

[25] The perspectives that have been offered in this chapter reflect the knowledge, interests, values and beliefs of the author and while I have tried to include a diversity of views, SOHO systems theory points to the need to involve a diversity of actors to complete the systems narratives, and emphasizes the contingent and partial nature of all system descriptions. This process could conceivably be ongoing (realtime) and iterative, producing further managerial complexities and needs for increased involvement by interested stakeholders and marine users in management planning and implementation.

about globalized fishery systems such as those in Newfoundland and Labrador (Peterson and Parker 1998, Kay *et al.* 1999, Boyle *et al.* 2001). Dams, for example, alter the physical context of entire regions and require large scale societal resources to construct and maintain often at numerous scales of governance including transnational venture capital and long term contracts. Aquaculture sites tend to alter contexts more locally; however industrial aquaculture operations can exhibit cross-scale feedbacks when farms draw on fishmeal, therapeutics and terrestrial agricultural products from around the world. In addition, aquaculture management involves both tangled and nested institutional hierarchies that are contested and complicated by unequal power interests (Naylor *et al.* 2000, Bavington 2001, Pauly *et al.* 2001)[26].

Recent attention to nested scalar relations and tangled institutional hierarchies has been used to explore the uneven management of inshore and offshore fisheries that target fish at different life stages from a variety of sub-populations. When the population theory of fish migration was developed by Heincke in the 1890's, North Sea herring (contrary to popular belief) were shown to exist as isolated populations and management was proposed at the local level corresponding to individual inshore stocks. Management for individual populations was rejected, however, because industrial fishing permitted the discovery of abundant offshore herring populations throughout the first half of the 20th century (MacGarvin 2002:18). Scientific "discoveries" of genetically distinct bay stocks of cod have rekindled calls for localized small-scale management and meta-population

[26] Third World debt, global trade rules and food safety standards originating in societal systems (institutional structures) at various scales can feedback to influence where fishing and aquaculture activities take place and the practices they employ. These feedbacks ultimately loop back into ecological structures and the physical environmental context. In the current political economy managing these feedbacks can be deemed protectionist and in violation of international trade rules and regulations.

analysis is leading to a "growing awareness that the [Northern cod] 'stock' is made up of more or less discrete local populations" (MacGarvin 2002:22) with implications for reformed fisheries management focused on habitat protection through marine protected areas and recovery programs with smaller management units and local involvement in designing and implementing management plans (Smedbol *et al.* 1998, Taggard *et al.* 1998, Wroblewski 1998/1999). Reflecting the above trends, Hutchings *et al.* (2002:176),

> ...contend that the management of cod needs to be guided by the precautionary understanding that they are likely organized into different subpopulations that vary in terms of their spawning locations, direction, timing and extent of their migrations, and that these behaviours, particularly migrations, probably are susceptible to changes in response to fishing pressure. If closure of spawning areas is to be considered as a viable management option in the future, then inshore spawning areas need to be identified and protected to the same extent as offshore areas. If monitoring of the age structure and abundance of spawning groups of cod is deemed important, then inshore stocks warrant the same type of monitoring as do offshore stocks.

## 5.8 Ecosystem-Based Fisheries Management: Contested Meanings and the Challenge of Implementation

> The ecosystem approach requires scientists to look at fish stocks in the light of the whole marine environment which considerable complicates their task (Gray 2002:3).

Post-1992 cod fisheries managers are faced with a daunting task. The predictable statistical cod populations Canada claimed for nationalized use and managerial control in 1977 have been managed into endangerment. Wild cod are increasingly represented as elements in precarious and largely unpredictable self-organizing eco-social systems influenced by fluctuating environmental and economic conditions and a host of human feedbacks that both include, and transcend, fishing-related mortalities. Ecosystem-based approaches point to the need for fundamental changes in population-based fisheries management as wild cod populations continue to decline. However, there are two vastly different responses to ecosystem-based fisheries management that are vying for support. One is aimed at assimilating "the ecosystem approach, like the precautionary approach, within the existing methodology of fisheries science...The second response is to abandon the existing methodology of fisheries science, and, ceasing to try to measure fish stocks quantitatively, instead seek to monitor indicators of ecosystem health" (Gray 2002:3). The first response entrenches the control-oriented managerial status quo. Under this approach,

> Ecosystem management involving control of the whole resource and environment is what needs to be aimed for, however imprecisely we may hope to achieve our goals with present techniques (Caddy (FAO) 1999:17).

The second approach to EBFM focuses on the irreducible complexity of marine ecosystems and accepts that wild cod can only be "managed" from a coping and adaptive stance that emphasizes the control of human interactions with wild cod as opposed to the manipulation of idealized populations abstracted from their unique eco-social contexts. Under this approach to EBFM, monitoring shifts from a narrow focus on expertly obtained single species population information to permit accurate stock assessments and total allowable catch levels, to a much broader range of indicators of ecological health and integrity[27] that must be defined through negotiation with interested stakeholders. Fisheries management changes from the confident control of commercial fish populations for powerful economic interests, to a more humble focus on coping and adapting to ecological systems while attempting to facilitate the self-control of anthropogenic feedbacks that produce unsustainable socio-ecological contexts. The approach emphasizes institutional, attitudinal, value and behavioural change as well as spatial management focused on marine zoning, the establishment of marine protected areas (MPAs) and no-take zones. It has also tended to focus on the allocation of individual

[27] It is important to note that the terms "health" and "integrity" have a diversity of definitions and do not have an agreed operational meaning in ecosystem-based fisheries management (Garcia *et al.* 2003).

property rights to fish quotas that are calculated with larger margins of safety, versus the exact prediction of commercial stock biomass conceptualized as common state property.

The current political economy of neo-liberalism restricts the type of changes that can be implemented in fisheries management. Neo-liberal statecraft and market managerialism encourage cuts in government expenditures and the downloading of managerial responsibility onto individual ocean users. Government attention and rhetorical support for ecosystem-based fisheries management is occurring at a time when fisheries management institutions are experiencing intense pressure to cut back on their expenses and download responsibility and costs onto industry user groups, voluntary organizations and local levels of government. The fish processing industry has adapted to the lack of wild Northern cod by replacing them with crustaceans, other whitefish and cod from the North sea that are pre-processed in China, linking itself increasingly to globally integrated seafood markets.

In the present political climate entrepreneurial fishers are increasingly expected to help fund and participate in scientific data gathering, monitoring and management activities. While these initiatives have the *potential* to bring stakeholders together to learn from past managerial mistakes and antagonisms, the emphasis on cost cutting and shifting responsibility from state agencies to fishers runs the risk of passing on immense responsibilities without the necessary resources to implement effective ecosystem-based fisheries management (Garcia *et al.* 2003).

The manageable wild cod, constructed carefully as a statistical single species population at the turn of the 19$^{th}$ century, has lost legitimacy in post-moratorium Newfoundland and Labrador. Wild cod, conceptualized as endangered elements in complex eco-social systems has led to a new type of fisheries management focused on the construction of manageable human beings and their relations with marine ecosystems.

# CHAPTER 6

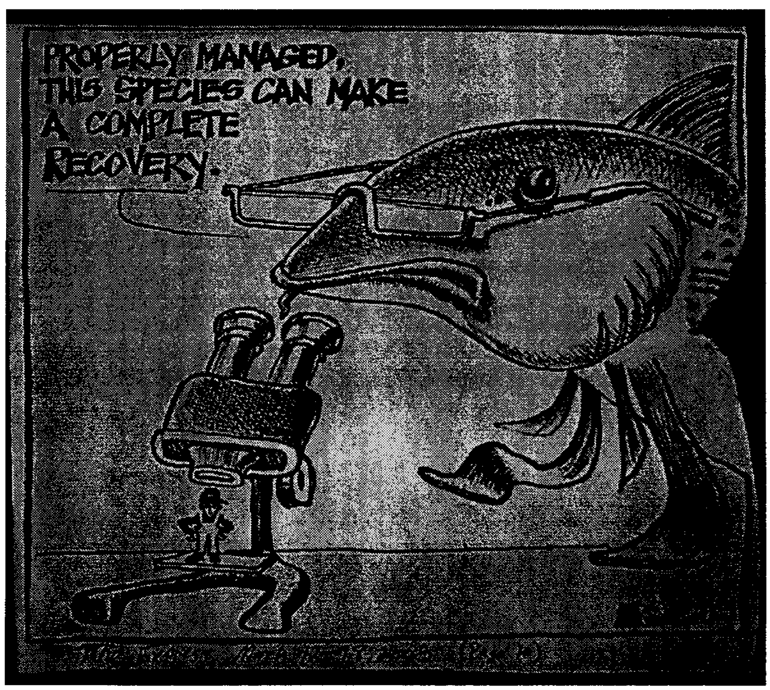
## From Managing Cod to Managing People

> Fisheries management means managing people; not the fish (Bundy 1998:366).
>
> Of the three components of fisheries management – habitat protection, enhancement of fish production, and the regulation of the fishermen – I have now set aside habitat protection as too somber and enhancement of fish production as too technical. The remainder of my remarks will be focused on the regulation of fishermen, which is a much easier topic. In my experience, fishermen haven't changed much over the last 50 years, and won't change much for the next 500 either...Fishermen are also much the same in fresh or salt water. I've chosen, then, to speak not just of inland fisheries management, but of managing fishermen wherever and however they fish (Larkin 1988:3).
>
> There are a lot of things here that are way beyond our control...The one thing we are in control of is the fella at the bottom of the ladder. (Inshore fisherman, FRCC 2003a).

While ecosystem-based fisheries management models offer expanded representations of codfish, emphasizing their biophysical contexts and the complex evolving interconnections they have with other species, this chapter argues that the dominant representations of fishing people in new forms of cod fisheries management lack reference to these rich contextual details and complex historical interconnections. Following the example of Larkin (1988), quoted above, fishing people are often represented as simplified caricatures that can be easily managed. These caricatures universalize assumptions of human nature and the nature of fishing that predominate in neo-liberalism and market managerialism. Over time, these caricatures and simplified assumptions have not only reflected but also helped to construct and transform fishing people and their historically complex, context dependent knowledge, beliefs, values, motivations, behaviours, identities and ways of life. Like the simplified images of cod, modelled as single species populations, that formed the foundation of state-based management in the pre-moratorium period, simplified images and models of fishing people form the core of contemporary approaches to fisheries management. By representing fish in complex ways and fishing people as relatively simple caricatures the latter have come to be understood as easier to manage than the former (Bavington 2002 and *see* Figure 6.1).

**Figure 6.1** "Properly Managed this Species Can Make a Complete Recovery"

This cartoon illustrates a new belief prevalent in fisheries management—that it is fishers that must be managed, not fish. The cod in the cartoon wears bifocals reflecting the accoutrements of a fisheries scientist or government bureaucrat. The "cod manager" focuses his gaze down a microscope at a small fisherman. The small individual fisherman under the microscope, separate from all complex interconnections and stripped of history, is a good illustration of the simplistic caricatures that form the foundation of much contemporary fisheries management. The microscope can be read as an indication of the reductionist "normal" science that studies objects in isolation from their supporting contexts in an effort to achieve prediction and control (Pickersgill 2003:10).




While addressing many of the problems and power relations associated with top-down, state-based, scientific fisheries management, contemporary forms of cod fisheries management that emphasize the management of people over fish have produced new problems. They have created new forms of power associated with neo-liberalism and the use of individual resource users and markets rather than bureaucrats and central planning as preferred management tools. In contrast to the original cod fisheries management regime, new approaches emphasize that most of the factors that affect fluctuations in wild cod abundance and global seafood markets lie beyond the reach of managers. This has not meant, however, that cod fisheries management has come to an end. Fisheries management interventions in Newfoundland and Labrador have abandoned state-led attempts at controlling cod stocks and seafood markets. However, cash strapped state-based fisheries managers now focus on transferring responsibility for fisheries management functions onto fishery resource users and others who lack power and are therefore easier to control—"the fella at the bottom on the ladder" (FRCC 2003a). This chapter addresses some of the new problems and power relations associated with this dramatic switch from managing cod populations to managing fisher-people in an age of neoliberalism and "market-knows-best" ideology.

As Zygmunt Bauman (2001:208) observes the "essence of power is the right to define with authority, and...the right to invalidate and ignore the definitions coming from the adversary camp." The remainder of this chapter is organized around five descriptions of attempts at authoritative (re)definition by cod fisheries managers in Newfoundland and Labrador in the wake of the cod fishery collapse. The first description explores the incorporation of fishers' local ecological knowledge into cod fisheries science and management. The second describes attempts by fisheries managers to define the structure of fishers participation through the creation of a co-management institution called the Fisheries Resource Conservation Council (FRCC). The third explores attempts by the Department of Fisheries and Oceans to define fisheries resources as private property as opposed to state-owned common property. The fourth describes the construction of the fishery as a risky activity to be managed by individual fishing participants rather than the federal government. The fifth explores the authoritative definition of fisher identity through the development of the professional fish harvester program. These five examples are presented as illustrations of simplifications that have been necessary to create new forms of cod fisheries management aimed at managing fishing people.

As this chapter will make clear, the switch to managing fishing people rather than codfish has not proven to be as easy or straightforward as Larkin's (1988) comments would have one believe. Indeed, the chapter concludes by discussing how simplifications related to the management of fishing people rather than wild cod have ironically helped to create conditions that encourage a return to managing codfish—this time through the domestication and commodification of their complex lifecycle on industrial fish farms.

## 6.1 From Exclusion to Inclusion: Putting Inshore Fishers Knowledge to Work in Science and Management

> We have to wait for them [DFO scientists] to say there is or there isn't fish, our experience don't mean a thing." (Inshore cod fisherman *quoted on the* Fisheries Broadcast 2003).
>
> If there is any fishery…it must be limited to fishers that bring the maximum data return back for information…Any fishery that we have is really in place to bring information back [to DFO], there's very little fish to give out as all of you know" (Fisheries Resource Conservation Council Member, FRCC 2003a).

The local ecological knowledge (LEK) of inshore cod fishers, once dismissed by fisheries managers as unscientific and anecdotal, is increasingly embraced and integrated into new forms of cod fisheries management (Murray *et al.* 2005). Local ecological knowledge (LEK) is knowledge that is derived from experience. Franklin (1990) has termed it 'vernacular knowledge' and others have referred to it as 'tacit knowledge' (Scott 1998). As Murray *et al.* (2005:4) note with reference to their research in Newfoundland and Labrador:

> By using the term "LEK" we do not mean to imply an attention only to ecology, or strictly to the bio-physical environment from which humans are too often considered separate. In our research, we are concerned about the physical and biological components of ecosystems (the fish, the tides, water conditions etc.) ... but we also ask about fishing and issues related to the larger social and economic context of fishing. Furthermore, we recognize that fishers change – and are changed by - more than bio-physical/ecological conditions. They are also embedded in a complex web of 'social' conditions: management regulations, kinship ties, peer pressure, social support mechanisms, and most importantly perhaps, the global seafood market. LEK is therefore a socio-ecological product, reflecting social and ecological times and places as well as culture and other institutions, and is mediated by labour processes, technologies, modes of management, economic, and ecological conditions.

A number of factors have helped to encourage a shift in managerial attitudes towards cod fishers' LEK in the post-92 period. First and foremost is the fact that most of the remaining cod that exist in Newfoundland and Labrador waters are aggregated into small, spatially dispersed coastal populations located inshore (Wroblewski 1999; DFO 2003a *see* Figure 6.1). As Wroblewski (1999:72) explains,

> Inshore components associated with the bays and headlands of the coastline...were considered of minor importance in managing the northern cod resource... However, recent reports of large aggregations of cod in the major bays of eastern Newfoundland...and the near-absence of cod on offshore fishing grounds of the continental shelf...have heightened scientific interest in the population structure and dynamics of inshore northern cod.

Another factor that influenced managerial attitudes towards cod fisheres' LEK was the loss of data on cod that accompanied the collapse of offshore stocks. Prior to the moratorium in 1992, data for cod stock assessments and management models were obtained exclusively from large offshore commercial groundfish trawlers and annual randomized survey trawls conducted by DFO on the offshore fishing banks (Finlayson 1994). When cod stocks and other groundfish populations collapsed in the early 1990s, the offshore commercial ground fishery collapsed with them, and many commercial trawlers were sold off to foreign countries (Murray *et al.* 2005). This eliminated an important source of data that DFO had used in their cod stock assessments and fisheries management modelling.

Furthermore, throughout the 1990's, DFO's science and management budget was slashed by approximately 40 per cent leaving fewer resources committed to cod science, monitoring, management and enforcement (FRCC 2002a, Rose 2003, CBC 2004a). During the budget cuts many permanent full time employees at DFO were replaced by temporary part-timers and private contractors and time at sea on research vessels was significantly reduced (FRCC 2002a, Rose 2003). In the wake of the cod collapse and budget cuts, DFO had to find ways to manage the remaining inshore cod populations while at the same time achieving cost reductions (FRCC 2002a). The incorporation of fishers' local ecological knowledge into DFO's cod fisheries science and management program was one of the ways the department responded to these ecological and economic challenges and restrictions.

The Sentinel Fishery program was the most prominent of DFO's local ecological knowledge initiatives designed to integrate cod fishers knowledge into fisheries management. Established in 1993 and significantly expanded in 1995 it was collectively organized by DFO and the Fish, Food and Allied Workers' Union (FFAW) which represents Newfoundland and Labrador fish harvesters (DFO 1995a). The Sentinel fishery was designed to make inshore cod populations legible to fisheries managers by prescribing fishing practices that would yield statistically significant annual results. As DFO (1995a:1) explains:

> Under sentinel fishery projects, commercial fishermen, who are specially trained in data collection methods, gather information on groundfish stocks by fishing in pre-established areas under pre-established guidelines.

Fishers participating in the Sentinel fishery were paid by DFO to fish in precise locations using standardized gear at specific times of the year. They tagged and measured the fish they caught and extracted otoliths to help scientists age the landed fish. Due to the need for statistically significant information to feed into single species population models, gill nets became favoured over other forms of fishing gear such as cod traps or baited hand lines for which it was more difficult to quantify catch-per-unit effort accurately and consistently (FRCC 2003a).

Perhaps due to this narrow use of fishers' local ecological knowledge, Sentinel fisheries for cod have become highly contested. Some fishers have unsuccessfully sought to influence the design of the program arguing that gear types other than gill nets should be used, and disagreements about the accuracy and interpretation of the catch-rate information have erupted between Sentinel and non-Sentinel fisherpersons and between fishers and scientists (FRCC 2003a, COSEWIC 2004)[1]. Some fishermen and women argue that their *experiences* on the water do not confirm the *experimental* results of the Sentinel survey (Fisheries Broadcast 2003, FRCC 2003a, COSEWIC 2004). This may reflect the fact that stock assessment science relies heavily on catch rate information developed under controlled, repeated (and therefore statistically valid) circumstances.

The protocol involved in fishing for science is quite deliberately different from commercial, recreational, and subsistence fishing practices. For example, commercial fishers, using mobile gears such as gill nets or bottom-trawls, can sustain high catch rates under a variety of stock conditions by varying effort across time and space (Harris 1990).

[1] During the early years of the Sentinel fishery program, line-trawls, cod traps and baited hand-lines were used in the survey. Over time, the use of these gear types were gradually reduced as standardized gill nets became the favoured gear.

Fishers using fixed gears such as cod traps can only catch fish when cod migrate into inshore shoal water and fishers using baited hand-lines require cod to be hungry before they will go for baited hooks. Different fishing gears, therefore, lead to different forms of knowledge, and different assessments of stock abundance that are more or less difficult to integrate into fisheries management systems.

While fishing people were paid to fish for DFO and to obtain knowledge and familiarity with the scientific methods used in the Sentinel fishery and other scientific stock assessment procedures, this appeared to strengthen, rather than reduce, scepticism of DFO's science and management, contrary to the intentions of the Sentinel program (Murray *et al.* 2005). Fishers argued that the Sentinel fishery program produced high levels of uncertainty about the actual state of coastal cod abundance since the fishery used short time series, limited knowledge of fish behaviour, and random, sparse sampling of mobile cod populations (FRCC 2003a, COSEWIC 2004). Much like the scientific knowledge gathered prior to the cod fishery collapse, the uncertainty associated with the knowledge gathered in the Sentinel fishery permitted "interpretive flexibility" (Finlayson 1994) and divergent conclusions on the health and abundance of coastal cod stocks (Murray *et al.* 2005).

Interpretive flexibility in data related to the cod fishery had produced conflict between DFO and cod fishers in the past. In the 1980's, inshore fishers argued that cod were scarce when fisheries scientists claimed they were abundant (Neis 1992). Since 1992, many fishers claim that several coastal cod stocks are abundant while most fisheries scientists and managers believe that the evidence suggests Newfoundland and Labrador cod stocks have continued to decline and are faced with extirpation and endangerment (COSEWIC 2003/2004). These dramatically different interpretations of the status of cod flow from fundamentally incommensurable types of knowledge, fishing practices, and beliefs about what constitutes evidence of abundance, and the scale of analysis that is taken to be proper and fitting.

The Sentinel fishery, and the management of coastal cod it has enabled, illustrate the power that DFO continues to hold over the local ecological knowledge of inshore cod fishers. By specifying how, when and where inshore cod fishing occurs, and selecting who can participate, the Sentinel fishery program has allowed DFO to maintain their authority to define the official meaning of inshore fishers LEK and the status of cod abundance. However, the Sentinel program also illustrates that inshore cod fishers do not easily believe the experimentally-based claims of fisheries scientists and managers when these experimental assertions contradict their fishing experiences on the water.

The Sentinel fishery program permitted DFO to translate the inshore fishery and coastal cod into manageable objects. However, the program "represented the enrolment of fishers as technicians, and solicited a very narrow and transformed slice of inshore LEK without seeking to substantially change the relative decision making power of fishers, scientists and fisheries managers" (Murray *et al.* 2005:11).

## 6.2 Opening the Closed Door: From Top-Down Statecraft to Participatory Fisheries Governance

> The tradition of decision making in fisheries management in Canada has meant that conservation is often seen solely as a DFO role to be achieved in a top-down fashion through regulatory and enforcement processes. A more effective approach would be to change current approaches to give fisheries participants a *feeling* of ownership over the resource. DFO does not have the resources to regulate and monitor every fishing activity. The Department is convinced that it will not be possible to conserve Atlantic fisheries resources unless all resource users and stakeholders take greater responsibility for conservation (DFO 2001b:15 *emphasis added*).

> We want you to think that this is your [cod fisheries management] plan, ok? I mean it would be the happiest day for me if you considered this your plan. I don't want it to be mine. I want it to be yours. That's the only way it is going to work (FRCC Member, FRCC 2002a).

After years of demanding to be let in, the doors to participation in cod fisheries management have swung open for cod fishers. Since the cod fisheries collapse in 1992 the Department of Fisheries and Oceans (DFO) has increasingly moved away from top-down management and has begun to emphasize collaborative partnerships and co-management arrangements with the fishing industry and individual fishers. Fishers can now become directly involved with cod fisheries management including providing advice on when, where, and under what conditions moratoria should be lifted on cod fisheries.

Over the same time period, however, DFO has undergone significant budgetary cuts and has seen its mandate expand to include greater management responsibilities for Oceans (DFO 2002b), transportation safety, and search and rescue (Murray *et al.* 2005). This has placed significant pressure on the department to do more with less, and has meant that "the fishing industry *must* increase its management capacity and expertise" as DFO cuts back, downloads, and redistributes managerial tasks once considered their exclusive responsibility (DFO 2001b:36 *emphasis added*). With the right to participate in fisheries management have come significant costs and responsibilities for fishers in Newfoundland and Labrador.

Like many government-run programs, DFO's fisheries management initiatives experienced a loss of legitimacy in the 1990's. This was facilitated by the collapse of the cod fishery and the rise of influential neo-liberal policy initiatives that aimed at transforming welfare bureaucracies charged with managing common state property into entrepreneurial, market-oriented agencies focused on enabling self-organizing private property regimes (Jessop 2002, Mansfield 2004, McCarthy and Prudham 2004). Under these material and ideological conditions, fishers were encouraged to take on more of the costs of fisheries management as the DFO created an extensive fisheries governance regime[2].

Fishers are now required to assist in the delivery of DFO's fisheries management programs in a number of ways that were not required prior to 1992. Scientific data gathering, monitoring, regulatory enforcement, management planning and decision making processes have been increasingly transferred to fishers. The new participatory management programs established since 1992 include: (1) the collection of data through surveys, logbook programs and other stock assessment processes such as the Sentinel fishery (FRCC 2002a); (2) paying for on-board fishery observers and dockside monitoring programs (COSEWIC 2004); (3) equipping their boats with GPS locator boxes linked back to DFO headquarters (FRCC 2003a); (4) reporting poaching activities to anonymous snitch lines established by DFO (2004c)[3]; and (5) spending an increasing

---

[2] As DFO (2001b:36) defines it: "The term 'governance' refers to the various systems of authority and decision making in fisheries management. It goes beyond what government does to include the participation of industry and other stakeholders in consultation and planning processes."

[3] Anonymous snitch lines to report poaching activities are modeled on the successful "Crime Stoppers" program. 1-800 "Report-a-Poacher" lines have been established and a marketing rhetoric that emphasizes the common interests of federal fisheries officers and fishing people has been constructed through slogans such as: "We're all in the same boat...help us conserve and protect fish for our future." And, "Conservation protection is everyone's responsibility...Don't let poachers steal your resource!" (DFO 2004c). These public relations campaigns attempt to create a false sense of common interests and ignore

amount of time in collaborative consultations and decision making processes where they are expected to provide feedback on management plans and present solutions for managerial problems surrounding the design, implementation, monitoring and enforcement of fishing rules (FRCC 2002ab/2003ab, COSEWIC 2004).

In the face of heavy criticism following the collapse of the northern cod stocks and severe cuts to their budget, DFO attempted to transfer an increasing amount of responsibility and authority for fisheries management functions onto fisheries resource users. The rapid establishment in 1993 of the Fisheries Resource Conservation Council (FRCC) was the Department's first attempt to open up planning and decision making processes in cod fisheries management. The FRCC was established "to form a partnership between scientific and academic expertise, and all sectors of the fishing industry" (FRCC 2004a:1)[4]. In annual public meetings held throughout Atlantic Canada's four provinces, Nunavut and Quebec, the fifteen person council was charged with creating a forum for information sharing and collaborative management planning between fishers, seafood processors, academics, government scientists and other interested members of the public. After widespread consultations, the FRCC published annual stock status reports and management recommendations reflecting what they heard. Status reports and management recommendations were made available to the public and

---

the social implications of reporting neighbors and fellow fishing colleagues to DFO (Welbourn 1996). They also obscure the fact that DFO has dramatically reduced its enforcement capability as a response to budgetary cuts and now *requires* the assistance of local people to carry out their legislative mandate to effectively conserve, manage and rebuild codfish stocks.

[4] "The Council consists of 15 members, appointed by the Minister of Fisheries and Oceans, with an appropriate balance between 'science' and 'industry'. Members are chosen on merit and standing in the community, and not as representatives of organizations, areas or interests: 'science' members are drawn from government departments, universities or international posts, and are of an appropriate mix of disciplines, including fisheries management and economics; and 'industry' members are knowledgeable of fishing and the fishing industry, and understand the operational and economic impacts of conservation decisions. Members appointed from DFO serve 'ex officio'. The four Atlantic Provinces, Quebec, and Nunavut may each nominate a delegate to the Council" (FRCC 2004a:1).

were presented to the federal Minister of Fisheries and Oceans who was expected to make use of them in making decisions related to cod, and other commercially harvested groundfish species[5] (FRCC 2004a).

The FRCC represented a significant departure from past practices when fisheries management decisions were made behind closed doors. Before the establishment of the council, scientific data from offshore scientific surveys and the commercial dragger fleet were reviewed exclusively by fisheries scientists to determine cod stock status. Once the stock status was agreed upon, total allowable catch (TAC) levels were secretly negotiated by DFO officials and hand-picked representatives from the fishing industry (Neis 1992, Finlayson and McCay 1998, McCay 2002a). The creation of the FRCC represented a break with this history of unaccountable top-down management since it created the opportunity for transparency and public participation from fishermen and women in reviewing DFO's scientific data and presenting management recommendations directly to the Fisheries Minister. The Minister was expected to use the FRCC recommendations when considering lifting moratoria and when determining total allowable catches, fishing licenses and individual quotas in reopened cod fisheries.

Since 1993 the FRCC has consistently emphasized opening up and stabilizing the cod stock assessment process and allocating individual quotas for cod and other fish stocks to resource users based on their level of participation in fisheries management functions (FRCC 2003a). The FRCC and the Department of Fisheries and Oceans believe that fishers who agree to participate in conservation and management efforts should be guaranteed access to cod when (and if) the stocks recover to avoid "free riders"

---

[5] The FRCC began by making recommendations on cod and other commercial groundfish species. Recently the council has had their mandate extended to include commercially harvested crustacean species such as snow crab (FRCC 2004a).

benefiting from the self-management and conservation-oriented behaviour of others (FRCC 2002a). This belief in stabilizing stock assessments and using economic incentives to encourage cod recovery and conservation is reflected in the following comments made by a leading FRCC member at a meeting to discuss cod stocks in NAFO division 3Ps on Newfoundland's southwest coast.

> When we have asked the question over the years—what is one of the key things, the most important thing to you about your fishery. The word that always comes back more than anything is stability. That's what people seem to want. You don't want it [quotas] jumping around all over the place, just based on what the current science is. We agree with that...because we know that the fluctuations that occur in the science models represent fluctuations in the science models more than they represent fluctuations in the stock...We can't expect people to buy into conservation unless they are the ones who draw out of the bank as well as pay in...I am not putting my money in the bank so someone in Nova Scotia can draw the interest. I mean that would be kind of foolish... (FRCC Member, FRCC 2002a).

The ultimate goal of the FRCC, and other co-management reform initiatives pursued by DFO, is to develop the management capacities of fishers and fishing corporations so that responsibilities for fisheries management functions can eventually be transferred away from the federal government onto resource users themselves (DFO 2001b). DFO has argued that this downloading and devolution is necessary because cod and other fisheries management is becoming more expensive, complicated and challenging. In addition, DFO claims that fishing corporations, seafood processors and fishers themselves are now "demanding greater control over their day-to-day operations and greater influence over the overall management of the industry" (DFO 2001b:36).

The arrival of the FRCC occurred amidst a general (in Newfoundland and Labrador and elsewhere) lack of confidence in centralized, state-based, bureaucratic scientific management. In the years prior to 1992, and with increasing frequency immediately after the cod collapse, many fisheries participants and fisheries management scholars actively called for participatory co-management institutions such as the FRCC to be established

(Pinkerton 1990/1994, Grafton 1993, Felt *et al.* 1997, Apostle *et al.* 1998, Berkes *et al.* 2001, McCay 2002a, Berkes 2003, Mansfield 2004). In theory, once co-management and participatory fisheries governance institutions such as the FRCC were established greater citizen-led control, community empowerment, equity and inclusive democratic participation would be forthcoming (Berkes *et al.* 2001, McCay 2002a). In practice, however, participatory governance in the Newfoundland and Labrador cod fishery fell far short of these idealistic objectives. The unique neo-liberal form of participatory co-management that DFO began to implement in the wake of the cod fisheries collapse became highly contested and criticized for downloading fisheries management onto fishing people and seafood corporations without obtaining changes to Canada's fisheries legislation or providing the necessary budgetary resources and desired property rights (FRCC 2003a, COSEWIC 2004).

While the FRCC was enabled to share scientific information about the state of the cod stocks with fishers, and was able to gather advice on cod management strategies and present recommendations directly to the Fisheries Minister, the Minister was not legislatively mandated to act on the council's recommendations. Under Canada's *Fisheries Act* all responsibility for executing management functions and making decisions related to the cod and other fisheries remained exclusively with the Federal Fisheries Minister. The concentration of managerial authority in the hands of the Minister meant that while fishing representatives often attended local FRCC meetings to voice their concerns they also directly lobbied the Fisheries Minister in Ottawa to attempt to gain influence over fisheries management decisions. Participation in cod fisheries management, therefore, became split between a transparent public process run through the FRCC meetings and private lobbying that occurred behind closed doors with the Fisheries Minister (FRCC 2002a). This situation undermined the significance of the FRCC since what was supposed to be a participatory management institution turned into one stakeholder group among many vying for influence over the Fisheries Minister (FRCC 2002a/2003a).

Fisheries Ministers since the establishment of the FRCC have consistently ignored many of the council's management recommendations on cod (FRCC 2003a). Therefore, while most fishers express support for FRCC stock status reports and management recommendations there is cynicism about the overall process (FRCC 2002a/2003a; Newfoundland and Labrador 2003, COSEWIC 2004). The extent of the Minister's authority and the fragility of the FRCC's participatory management approach was vividly illustrated in 2004 when federal Fisheries Minister Geoff Regan decided unilaterally not to ask the FRCC to provide him with advice on cod stocks along the northeast coast in NAFO divisions 2J3KL. The FRCC and many cod fishers from the northeast coast had planned to argue for reopening a limited commercial cod fishery in 2005. The fishery had been closed indefinitely by the Minister in 2003 in direct opposition to advice from the FRCC (2003ab) and an All Party Committee Report produced by the provincial government (Newfoundland and Labrador 2003). The Minister's refusal to consult with the FRCC on the northeast coastal cod removed all avenues for public participation in cod fisheries management for the stock, terminating a process that had been in existence since 1993. The Minister's action led to widespread condemnation from fisheries stakeholders and illustrated that while the FRCC had enabled participation in fisheries management it had not been able to provide an avenue for citizen-led control or legally mandated co-management arrangements in the cod fishery (COSEWIC 2004, Dean-Simmons 2004b).

### 6.3 Privatization, Fleet Separation and Canada's Fisheries Act: Attempts to Create Market Friendly Fisheries Legislation and Policy

A central assumption of DFO's participatory management approach is the belief that private ownership of fisheries resources is required to create economic incentives for resource users to take on costs associated with fisheries management and to develop stewardship ethics and conservation orientated behaviour (Burke and Brender 2001, DFO 2001b, Van der Schans 2001, Vardy and Dunne 2003). DFO began to implement this privatization vision by allocating individual quotas (IQs) to cod stocks and restricting access to fishing licenses after the declaration of Canada's 200 mile limit in 1977. Starting with individual enterprise allocations and restricted licensing in the offshore fleet, it took DFO until well after the cod collapse in 1992 to establish individual quota allocations and restricted licensing in the inshore cod fishery (Burke and Brander 2000).

DFO argued that IQs helped to stabilize individual and corporate access to fish stocks, reducing the "race to fish" that was associated with broad fleet level quota allocations (Burke and Brander 2000). The department also discovered that "the level of licence holder participation in the management of IQ programs [was] generally greater than in non-IQ programs" (Burke and Brander 2000:27). Privatizing allocations through IQs, therefore, allowed fisheries management functions to be increasingly turned over to economically interested resource users (DFO 2001b, Vardy and Dunne 2003). IQs also created the possibility for sensitive allocation, and hence equity issues, to be settled increasingly through the operation of markets in individual transferable quotas (ITQs) as opposed to politicized decisions made directly by the Department and the Minister of Fisheries and Oceans (Burke and Brander 2000, DFO 2001b). The Department realized that by privatizing access to commercial cod and other fisheries through limited licensing and ITQs, the economic value associated with the right to fish would dramatically increase allowing the department to demand increased participation in management functions by fisheries resource users "either through paying for them or through direct participation in the function" (Burke and Brander 2000:27).

However, despite enthusiasm for privatization versus central planning at the Department of Fisheries and Oceans, their vision of a self-managing, free-market fisheries management utopia ran into significant challenges. The Federal Fisheries Minister continued to maintain complete legal authority over fisheries management decisions under Canada's *Fisheries Act* including the right to allocate and withdraw fishing quotas and licences (Canada 2004). The *Fisheries Act* specified that fishing licences and quota allocations had to be renewed annually by the Minister and could be revoked at any time. This removed stability and security of tenure for fisheries license and IQ holders making it impossible for fishers to gain access to loans and credit from banks and other financial institutions to help fund the costs associated with capital intensive fishing and the management functions being downloaded onto them by DFO (Vardy and Dunne 2003, Power 2005, Murray *et al.* 2005). Without being able to offer security of tenure for fishing access and quota rights, DFO had a difficult time encouraging fishers to "buy-in" to their co-management and participatory fisheries governance initiatives which, like the FRCC process, appeared to offer additional costs and responsibilities without corresponding rights and privileges (DFO 2001b, FRCC

2002ab, COSEWIC 2004). Legislative and regulatory restrictions under Canada's *Fisheries Act,* along with a decreasing budget to live up to expanding ocean management obligations, left DFO in a precarious position in their efforts to implement participatory fisheries governance in Newfoundland and Labrador (DFO 2001b:20).

A bill to revise the *Fisheries Act* to address the lack of secure private property rights in the fishery was put forward in 1999 (Burke and Brander 2000). The bill contained provisions that would have authorized the Minister of Fisheries and Oceans to enter into long-term, legally binding, partnership agreements with fishing corporations and groups of fisheries resource users, thereby stabilizing and extending the legal standing and secure property rights in commercial fisheries and eliminating the uncertainty associated with the Minister's annual reviews (Burke and Brander 2000). DFO promoted the bill "as the next logical step in the evolution of co-management," arguing that it would offer "long term security of access to groups willing to accept responsibility for management" (Burke and Brander 2000:34-35). However, despite support from the Department, the bill faced considerable opposition from common property advocates and it failed to pass into law (Government of Canada 1998). Despite this legislative setback in 1999, DFO's 2001 *Atlantic Fisheries Policy Review* (AFPR) continued to advocate so-called "rights-based" fisheries management through the allocation of secure individual property rights to resource users and through restricted licensing.

Since the current legislative and regulatory framework has yet to be significantly amended, fishing people and fishing corporations have had to be convinced to take on a whole host of managerial responsibilities that are being abandoned by the federal government, without obtaining complementary guarantees of fishing rights or the authority to make legally binding management decisions. This in turn has created increased support within the fishing industry for privatized access to fisheries resources to obtain the necessary financial capacity to take on new management functions being downloaded by DFO (FRCC 2002a/2003a, COSEWIC 2004).

### 6.4 Individualizing and Privatizing Fisheries Management: From Confident State Management to Risky Self-Management

> The commercial fisheries must become more economically self-reliant and more responsible for handling fluctuations in the resource and the market...and responsibility for the well-being of coastal communities must be shared among resource users, communities themselves, DFO, and various federal and provincial government agencies (DFO 2001b:25).

In tandem with moves towards the incorporation of fishers LEK into fisheries management and shifts away from top-down approaches towards greater sharing of management responsibilities and accountability with resource users, the Department of Fisheries and Oceans has increasingly emphasized risks and uncertainties associated with fisheries management (DFO 2001b:36). In their 2001 *Atlantic Fisheries Policy Review*, DFO clearly articulates a new emphasis on risk and uncertainty.

> Uncertainty is an intrinsic feature of managing a living resource. Fish stocks are subject to changes in the ocean environment. Our ability to forecast the effects of these changes is imperfect; our ability to control them is non-existent. Conservation is paramount, but it does not mean avoiding all risks to stocks or species. What it does mean is avoiding unacceptable risks...Participants in fisheries management decisions must clearly acknowledge the existence of risk and, ideally, arrive at a consensus on an acceptable level of risk. In the event that risks become unacceptable, stakeholders must agree on the actions that are required (DFO 2001b:16).

This new emphasis on risk and uncertainty marks a radical shift from the confident forecasting and control-oriented approach associated with single-species scientific management that was applied to the cod fishery when Canada declared its 200 mile exclusive economic zone in 1977. DFO's new approach emphasizes personal rather than collective social responsibility to insure against a growing list of risks and uncertainties associated with natural fluctuations in fish landings, seafood market instabilities, and failures in fisheries management (DFO 2001b). In the process fisheries failures and catastrophic crashes have become categorized as "manageable risks" as opposed to "natural disasters" or "acts of God" (DFO 2001b, O'Malley 2003, Vardy and Dunne 2003).

Natural disasters and acts of God are understood as unpredictable events that are beyond the control of individuals (Higgins 2001). Since they present challenges and hardships beyond the scope of individual control, it was believed that these events were best responded to collectively by governments (Higgins 2001). Following this logic, the cod collapse in 1992 was presented as a "natural" disaster by the federal government. No individuals or fishing practices were officially blamed, unexpected natural changes in water temperature and salinity were focused on by DFO as causes of the collapse, and from 1992-2001 the Federal government provided 3.9 billion dollars in "income support, industry adjustment measures and economic development assistance programs for the Atlantic fishing industry" delivered through two Federal departments and one Federal agency[6] (DFO 2004b).

The aim of the moratorium disaster relief initiatives was to remove people from the cod fishery and decrease the federal government's role and responsibility in all future fisheries management activities (DFO 2001b). People were removed from the cod fishery through licence buy-back programs and by forcing all recipients of moratorium related funding to retrain for jobs outside the fishery. The government also tightened up

[6] These included: The Department of Fisheries and Oceans (DFO), Human Resources and Development Canada (HRDC), and The Atlantic Canada Opportunities Agency (ACOA).

eligibility requirements for Employment Insurance (EI), making it far more difficult for seasonal fishery workers to qualify for benefits (Power 2004b).

The overall message coming from the Federal government through their cod fisheries management policies throughout the post-moratorium period was that the fishery was an uncertain and risky activity that the government was no longer going to support as it had done in the past (Cashin 1993, DFO 2004b). After initial reports that the cod stocks would rebuild quickly within 2-5 years, fishers were eventually told that scientists did not know how long it would take before the cod stocks would rebuild, or if a vibrant commercial cod fishery would ever be possible in the future (DFO 2004b). The government's cod moratorium programs and policy statements encouraged all remaining participants in the fishery to "clearly acknowledge the existence of risk" and to take individual actions to manage the risks (DFO 2001b:16). What was once considered to be the world's most effective scientific fisheries management system began to rely on individual and corporate voluntarism, and the actions of financially motivated fishers to help manage the vast resources of Canada's EEZ (COSEWIC 2004)[7].

In the post-moratorium period, the Canadian government promoted the self-serving belief that wild fishery resources oscillate naturally, moving through cycles of boom and bust, much like the global seafood economy (DFO 2001b). It was, therefore, now up to individual fishing "enterprises" (real persons and legal "persons" or corporations) to privately insure against, and take individual responsibility for, risky ecological and economic conditions associated with fishing and fisheries management. The state was

[7] The downloading of formerly state-run ocean management initiatives onto the for profit private, and non-profit voluntary sectors extends beyond fisheries management to include Canada's coast guard through the Coast Guard auxiliary program, and includes an oil spill response initiative that organizes inshore fishers to help clean up oil spills in the case of a major disaster in inshore waters along the coast of Newfoundland and Labrador.

not to be relied upon to bail out fishers and their communities when the fishery underwent a downturn due to natural ecosystem fluctuations, over-fishing, or price fluctuations associated with global competition in seafood markets.

The government's role moved away from a top-down welfare state model, where risks associated with fluctuating fish landings were collectively managed, to a neo-liberal market-led approach. Under this new fisheries management regime catastrophic risks associated with fluctuations in wild fish landings were naturalized and responsibilities for managing these risks were downloaded with increasing frequency onto individual resource users. Rather than offering guarantees of stability and delivering state-based fisheries management functions, the Canadian government refashioned itself as an "enabler" and "facilitator"—attempting to create conditions that allowed fishers to manage themselves. The new self-managing fisher that emerged out of this neo-liberal participatory fishery governance was conceptualized as a capable entrepreneur, ably competing in globalized seafood markets by professionally harvesting fish using the latest technology rather than hunting them in a small boat as a needy welfare client making do with government hand-outs.

## 6.5 Self-Managing Fishers: From Artisanal Hunters to Professional Harvesters

> Professional fishers and artisanal fishers...This distinction is important in livelihood, organisational, and technological terms. The label of professional implies a small-scale entrepreneurial ethos where fishing has shifted from a community orientation to a business orientation. Professional organizations in North America and Europe tend to be aggregations of individuals who negotiate with the government for special considerations. The artisanal label, in contrast, emphasises collective community identities and traditional connection to the fishery while the organizational style is of mass mobilisation and protest as a means of negotiation with the state (Johnson 2002:117).

> Why is professionalization important? Professionalization identifies and recognizes those key, bonafide, full-time fish harvesters with attachment to and investment in the fishery. The primary advantage of having fishing acknowledged as a career is to provide stability and recognition to harvesters as they complete standardized levels of training and experience. Professionalization is the first step in securing the harvesters role in the fishery of the future. Professional Fish Harvesters will have to play a greater role in the management of the fishing industry. In any occupation, the receiving of professional status can give an individual a sense of pride, achievement and security. (PFHCBNL 2004).

Newfoundland and Labrador was the first province in Canada to legally recognize and promote fishing as a profession including a code of ethics and training standards (PFHCB 2000abc). In 1996 the provincial government passed the *Fish Harvesters Act* and the Department of Fisheries and Oceans established a new *Commercial Fisheries Licensing Policy* for Eastern Canada. The act and the policy complemented each other by mandating professionalization and full time "core" status for all commercial fishery participants. The provincial *Fish Harvesters Act* required that all persons engaged in commercial fishing in Newfoundland and Labrador had to become certified through the Professional Fish Harvesters Certification Board that created three designation levels for harvesters: Apprentice, Level I and Level II (PFHCB 2000a). DFO's *Commercial Fisheries Licensing Policy* (1996) was designed to limit and stabilize participation and entry into the fishery so that only full time "core fish harvesters" could participate. This was done to simplify fisheries management. By excluding part-time "moonlighters" fisheries resources could be concentrated in fewer hands ensuring a higher standard of living for those that remained and financial resources for the remaining participants to provide managerial functions. To maintain status as a core professional fish harvester, participants had to prove that they earned 75% of their income from full time fishing activities during the designated fishing season (May 1 to October 1) and that they did not hold full time employment outside the fishery (PFHCB 2000a).

When the professionalization act was established all licensed full time "core" fishers were grandparented in as Level II fish harvesters (Grzetic 2004). New entrants were assigned an Apprentice level and those without a licence who had participated in the fishery as crew members were assigned Level I status. In order to remain active in the fishery, all Apprentice and Level I fish harvesters had to obtain a specified number of hours fishing under the guidance of a Level II fish harvester and were required to successfully complete training and educational courses if they wanted to advance to higher levels (PFHCB 2000c). In order to qualify to purchase a fishing licence, fish harvesters had to obtain Level II status.

Professionalization created a standardized occupational hierarchy in the fishery and limited access to resources to those involved in officially sanctioned fishing activities. The professional fish harvester program also assumed "a particular path in people's learning" (Grzetic 2004:63). In order to advance from an Apprentice through Level I to a secure licence holding Level II position, individuals had to participate in both formal and informal learning activities as mandated by the professional fish harvester certification board. Fisheries professionalization courses had to be arranged through the Marine Institute, an arm of Memorial University located in St. John's. The Marine

Institute established a "Community Based Fishery Program" to deliver the professionalization training beyond their St. John's campus. However, the costs associated with the training and the administrative difficulties of arranging courses to be delivered outside St. John's meant "that fishers working aboard bigger vessels" and those who lived closer to St. John's were "more likely to access professionalization training than those on smaller vessels living in rural areas" (Grzetic 2004:65). In a study of the fisheries professionalization program, Grzetic (2004:67-68) found that it was difficult for women to meet the professionalization program certification standards and that financial and "institutional barriers" put the mandatory fisheries training program "far out of reach for the small-boat inshore fishers in rural communities."[8] One of Grzetic's (2004:67) informants named Gloria commented on the fisheries professionalization program in the following way:

> We had pamphlets come from the Marine Institute with a list of courses. It costs more to do those [fisheries professionalization] courses than it would to do a university degree...I think they want to get us out of the fishery and that's it.

The concerns expressed by Gloria illustrate succinctly both the federal and provincial government's goals for their licensing and professionalization programs. The provincial and federal government were interested in controlling access to fishing licenses and reducing the number of fishing people in the wake of the cod fishery collapse. Moves towards professionalization were called for as early as 1993 in the *Report of the Task Force on Incomes and Adjustment in the Atlantic Fishery* (Cashin

---

[8] Grzetic (2004:21) states that: "Men are concentrated at Level II and women are concentrated at the Apprentice level [and]...the greatest number of fishermen overall are in [NAFO division] 3L, which included some of the least rural areas of the province [including St. John's]." She also goes on to note that "one aspect of women's workforce patterns is that they often work part-time—for both voluntary and involuntary reasons (Armstrong 1995:369) and there is no longer a category for part-time fishers just as there is no category for "helper"" (Grzetic 2004:63).

1993). The report emphasized that responsibilities associated with fisheries management functions needed to be transferred from the federal government onto fishers. It argued that this would be helped along through the professionalization of fishing people (Cashin 1993).

The modernized fishing people imagined through the commercial fisheries licensing policy (DFO 1996) and the professionalization program (PFHCB 2000a) were dramatically different from those that existed before the cod fisheries moratorium. Through professionalization, fishing people were forced to become self-sufficient fish *harvesters* who learned how to fish at the Marine Institute as opposed to relying on oral knowledge passed on from family members who *hunted* fish on the fishing grounds. Professionalization involved an increasing "emphasis on the individual fisher as 'entrepreneur'" (Grzetic 2004:9) turning fishing people into newly responsibilized subjects (Taylor 1993, Maravelias 2003)[9]. Cod fisheries resources, previously understood to be common state-owned property open to the public for subsistence consumption and controlled commercial exploitation, were increasingly enclosed as fishing rights became privatized and individualized. The focus on individual fishing entrepreneurs "created a number of divisions among fishers—between inshore and offshore fishers, trap and gill-net fishers" and "pitted fisheries people against non-fisheries people" as familial individualism gave way to possessive individualism (Power 2004:204). These changes to the management regime "selectively benefited some

[9] Taylor (1993) describes the "age of responsibilization" as a time when the rise of individualism and freedom produce a society where people are called on to become increasingly self-responsible rather than relying on other individuals, community associations or state services. It involves an increasing prudential orientation to life and the self where decisions are made based on utilitarian calculations focused on the costs and benefits accrued to the individual apart from relational concerns or duties to others. The dynamics of this individuation under late modernism are explored in detail by the sociologist Anthony Giddens (1991) among others (Bauman 2001).

groups—namely men and investors, speculators and corporate entities—over others" and proposed "restricted access, exclusivity and privatization as solutions to the…environmental crisis" (Power 2004:164).

### 6.6 Conclusion: Self-Managing Fishers Harvesting Cod in an Enclosed Sea

> The greater the level of indeterminism in our conception of the world and of people, the higher the expected level of control (Hacking 1990:vii).
>
> A major shift is occurring in Canadian fisheries management. The state is in the process of dismantling its extensive fisheries regulatory regime and transferring the responsibilities for management to participants in the industry. This corporate model is evident in the state's efforts to enclose the fisheries via boat quotas and to limit participation through the core/non-core classification system and support for professionalization efforts that correspond with this direction (Power 2004b:211).

In the post-moratorium period the use of fisher's LEK in science and management, neo-liberal participatory fisheries governance initiatives, the emphasis on risks associated with fishing, and the professional fish harvester program have all reflected and helped to produce a dramatically new type of fisherperson in Newfoundland and Labrador. Rather than common stereotypes of fishing people as ignorant, needy, lazy welfare dopes, fishers are now represented as being capable, enterprising, owner-operators with direct financial stakes in both the failures and successes of fisheries management[10]. These newly independent fisher people, cut off from dependence on the welfare state, their local communities, and families are conceptualized as being better able to adapt to the uncertainties and complexities emphasized by ecosystem-based fisheries management and the highly competitive global seafood market. Cod fishers who have survived the

[10] These stereotypes are common with respect to seasonal fishing people in Newfoundland and Labrador who are represented in the media and by Federal agencies as fishing solely to obtain employment insurance benefits. Neo-liberal rhetoric associated with market managerialism casts this seasonal fishing activity in a negative light associating it with a "culture" of poverty and dependency. These negative stereotypes were often used to justify the need for a fisheries professionalization program in both print and broadcast advertisements promoting the professionalization program and at many of the fisheries meetings I attended during my research.

fishery collapse and remain in the fishery are presented by DFO as being more flexible and capable of making risky management decisions when compared to pre-92 fishers and the bureaucratic management agencies that administered state-owned fisheries resources though top-down expertise, rational-legal frameworks, and inflexible proceduralism.

The goals of LEK programs, participatory fisheries governance, risk management, licensing and professionalization in Newfoundland and Labrador have been economically driven, exemplifying a neo-liberal downloading mentality focused on cutting government costs associated with fisheries management (DFO 2001b, Schrank *et al.* 2003). Resource users (fisherpersons and fishing corporations) have been called on to absorb an increasing portion of the risks and responsibilities associated with fisheries management so that "...license holders and fleets" can "make their own business decisions and be accountable for the consequences" (DFO 2001b:26). DFO hopes that these changes will "spawn a new and positive fisheries management culture and usher in a new era of public-private sector co-operation in Canada's fisheries" (DFO 2001b:49).

The neo-liberal, market-driven approach to cod fisheries management favoured by DFO in the post-moratorium period emphasizes the management of fishing people rather than wild cod stocks, stressing bottom-up participation by economically interested stakeholders, public-private-partnerships, and the creation of responsible self-managing individuals and corporate 'citizens.'[11] Fishers have been encouraged to act more like corporate ranchers and farmers than hunters. They are to harvest fish rather than hunt it, on an ocean that has become ever more like the land—enclosed as property with laws and limits. These changes have come about by focusing on the construction and management

[11] As McCarthy and Prudham (2004:276) argue, "neoliberal notions of citizenship and social action are discursively repackaged in the image of *homo-economicus*, the ideal, entrepreneurial, self-made individual."

of simplified caricatures of fishing people. The complexity, uncertainty and indeterminism associated with representations of wild codfish have reached levels where the management of fish seems too challenging and difficult. However, through this process conditions have been created that favour a return to managing codfish, this time in laboratories and on farms where domesticated cod are to be controlled from egg-to-plate.

# CHAPTER 7

## From Hunting to Farming: Managing Cod From Egg-to-Plate

> You were looking at over a million tons of cod at the peak of the fishery and now you are looking at virtually nothing. So this was the opportunity that started me in cod farming. The opportunity is very much better now than it was in 1992 when the moratorium closed the fishery (Cod farmer, NAIA 2003).

The failure of single species fisheries management to predict and control fluctuations in cod abundance on Canada's east coast emphasized that managers, despite having one of the best fisheries science and management systems in the world, had little control over the abundance and productivity of wild cod populations. The moratorium on cod fishing and DFO's emphasis on managing fishers rather than cod did not lead to a rapid recovery of wild cod populations as was initially predicted. In 2003, after more than a decade of rotating fishing moratoria, several Newfoundland and Labrador cod populations were recommended for placement on the endangered species list by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003). Cod fisheries management appeared at an impasse, unable to deliver what it was designed to create—a stable, rationalized flow of cod resources that could produce economic value within a modernized Newfoundland and Labrador fishery.

The endangerment of wild cod, however, was not interpreted as a managerial impasse by everyone. As wild cod populations were declared endangered, aquaculturalists geared up to manufacture cod on farms. In the post-moratorium period scientists and entrepreneurs—with the help of significant expertise from universities and extensive financing and enabling policies from government—learned how to manage domesticated cod populations throughout their entire lifecycle. A cod hatchery was built and cod brood stocks were developed. Coastal grow out sites were surveyed and licences were issued. Dependable, scientifically formulated feed sources and government loan guarantees for the aquaculture industry were established and the demise of *Gadus morhua* was presented as a profitable business opportunity.

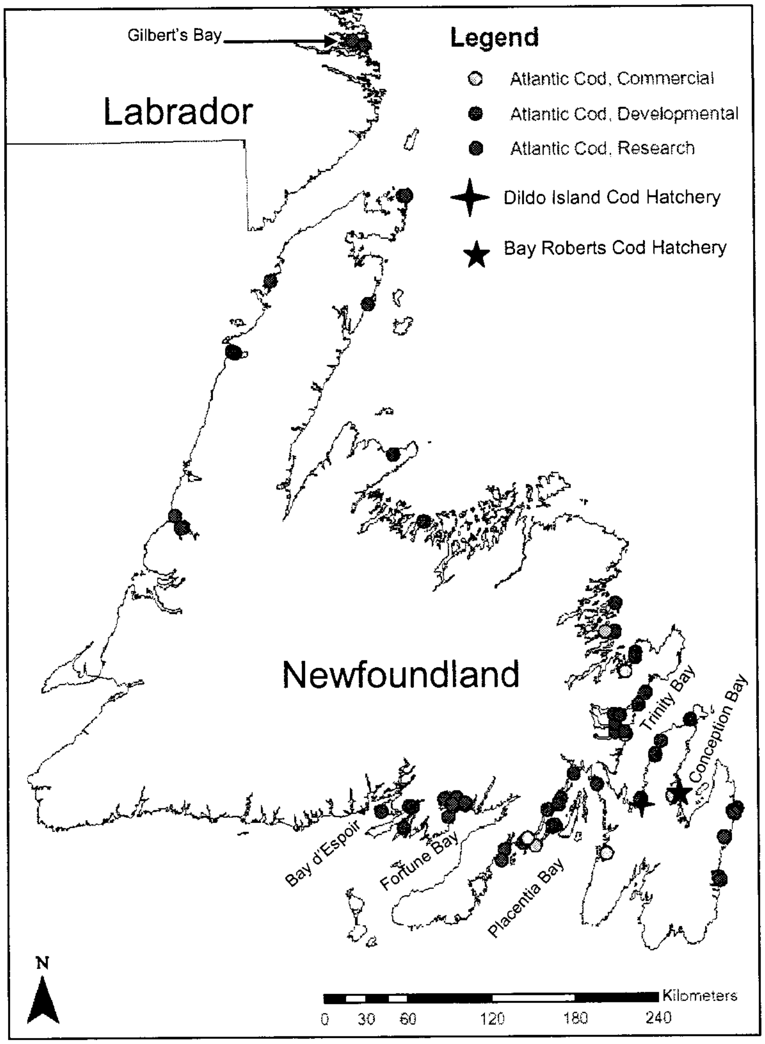
This chapter explores the shift from hunting to farming cod in Newfoundland and Labrador as an example of the intensification of managerial ecology in the face of wild cod fisheries management failure. It opens with a brief history of the domestication of cod in Newfoundland and Labrador. This is followed by an exploration of the federal and provincial government's role in promoting industrial cod aquaculture within a market-oriented management framework. The ecological risks and equity issues associated with cod aquaculture are then briefly discussed with an emphasis on the managerial challenges these pose for wild cod recovery. The chapter concludes with a reflection on egg-to-plate cod farming as the culmination of managerial approaches to cod and the cod fishery.

## 7.1 Domesticating *Gadus morhua* in Newfoundland and Labrador

> You cannot develop new markets without a consistent supply of product, and steady, predictable year-round production is the goal for every new species that is being brought into aquaculture. It is a question of getting animals to spawn when you want them to rather than when nature dictates. Scientists and industry are finding ways to alter the timing of these natural events to their advantage (Lockett 2001:56).

In Newfoundland and Labrador attempts to domesticate the lifecycle of cod to enhance production go back to the 1880's (NAIA 2002). In 1889 the Newfoundland government hired Adolph Nielsen, a Norwegian fishery expert, to construct a cod hatchery on Dildo Island in Trinity Bay (McGrath 2004 *see* Figure 7.1).

**Figure 7.1** Newfoundland and Labrador Cod Aquaculture Sites and Cod Hatcheries (Adapted from Department of Fisheries and Aquaculture AquaGIS website March 14, 2003).




The cod hatchery was promoted by the newly established Fishery Commission (1887) as a way to develop techniques "for the artificial propagation of codfish, with the view of restocking our exhausted bays" (Second Report of the Fisheries Commission 1889 *quoted in* Baker *et al.* 1992:26). Nielsen's hatchery work was financially supported by the Fishery Commission and the St. John's Chamber of Commerce in the belief that cod hatcheries would "counteract the destructive process of nature and the waste caused by injurious modes of fishing" (Report of the Fisheries Commission 1889 *quoted in* Baker *et al.* 1992:27). From 1890-1896 the Dildo island hatchery released millions of yolk-sac cod larvae at various locations in Trinity, Bonavista and Conception Bays becoming the largest cod hatchery in the world (Harrington 1987). While there was much debate over the hatchery's effectiveness, scientific evidence that the cod fry released from the hatchery had a positive impact on wild cod production and cod landings was lacking (NAIA 2002). When banks collapsed in Newfoundland in December 1894 the government cut funding for the hatchery and it eventually closed in 1897 (Baker *et al.* 1992)[1].

Direct attempts to augment wild cod production lay dormant until the late 1980's when a version of cod farming developed as an outgrowth of the wild fishery (Wroblewski *et al.* 2005). In order to add market value to small cod captured in the inshore trap fishery, a number of fishers began holding undersized wild cod in net-pens (Martin 1992). By feeding these cod readily available bait fish (male capelin[2], squid, small herring and mackerel) fishers were able to double the weight of the penned cod in 100 days (Wroblewski *et al.* 2005). This low tech version of aquaculture offered fishers additional control over how they used their quotas and when they had to sell their fish. Wild cod that were grown out for three months could be sold in the Fall when market prices peaked (Dean-Simmons 2002).

---

[1] Similar hatchery projects aimed at enhancing wild cod stocks were established at the end of the nineteenth century in the United Kingdom, Norway and the United States. Despite the popularity of these programs the scientific community criticized the release of hatchery produced yolk sac cod larvae claiming that there was little evidence of long term increases in the abundance of mature cod in any of the areas where larvae were released (Chan *et al.* 2003).

[2] Wild capelin fisheries target females for their eggs that are sold by Newfoundland fishers to buyers in Japan. This leaves an abundance of male capelin for which there is no market. Wild cod grow out was seen as an opportunity to use male capelin while increasing the value of undersized cod.

Wild cod grow-out operations were small scale, requiring under $100,000 in start up capital, access to a cod fishing license and readily available cod trap gear (DFA 2002). Since cod grow out utilized wild stocks that were captured locally and held at low densities there were relatively few environmental concerns associated with the practice (NAIA 2002). The short grow out time avoided problems associated with annual ice flows along the coast allowing wild cod grow out to be undertaken successfully throughout Newfoundland and even in the cold waters of Gilbert Bay in southern Labrador (Wroblewski *et al.* 1998, Bavington 2003ab *See* Figure 7.1 for locations). Wild cod grow out was supported by the Food, Fisheries and Allied Workers' Union (FFAW) and the provincial government: however, the practice was largely eliminated when the cod fishing moratorium banned access to most wild cod in 1992 (Wroblewski *et al.* 2005).

While the moratorium largely put an end to wild cod grow out, it spurred entrepreneurial dreams for the commercialization of full cycle cod aquaculture in the province. Unlike wild cod grow out, full cycle "egg-to-plate" cod aquaculture sought complete control over the lifecycle of cod with the aim of creating a fully domesticated farm animal that could be efficiently grown to compete in highly competitive seafood markets (Bavington 2001). In 2001, Northern Cod Ventures Limited began to develop a commercial cod hatchery in the town of Bay Roberts in Conception Bay as a first step toward large scale commercialization of full cycle cod farming in Newfoundland (*see* Figure 7.1)[3].

---

[3] A previous hatchery had been constructed in the 1990's in an abandoned fish plant in Placentia Bay. In 1997 the hatchery burned to the ground just as it was preparing juvenile cod for commercial grow out trials. The fire is cited by the aquaculture industry as a major reason for the delayed development of full cycle cod aquaculture in the province (NAIA 2002).

Northern Cod Ventures Limited drew on expertise developed at Memorial University's *Ocean Sciences Centre* where researchers had developed a cod brood stock program, an experimental hatchery, and feeding protocols to raise cod from fertilized eggs to juveniles ready for commercial grow-out (Boyce 2002/3). Financing for the hatchery was raised from the Federal government through the Atlantic Canada Opportunities Agency (ACOA) and a partnership involving a private Newfoundland aquaculture corporation and three provincial seafood processors (NAIA 2003). With a total cost exceeding three million dollars, the Bay Roberts hatchery was designed to produce up to 10 million cod fry per year (NAIA 2003).

Cod farming proponents are now working toward the goal of using hatchery produced cod fry to grow 32,000 tons of farmed cod on Newfoundland's south coast by 2010 (Fennelly 2003ab). This has led *Fish Farming International*, the world's leading source of aquaculture information, to proclaim a "Cod Comeback!" in Canada enthusiastically arguing in its December 2003 cover story that Newfoundland "—for centuries home to the world's biggest wild cod resource—could well become a world centre for cod supplies again through aquaculture" (Fennelly 2003a:1).

The hype and enthusiasm around cod farming expressed in the above quote from the world's top aquaculture trade publication conceals the many managerial challenges that have been associated with the domestication of cod. When compared to readily farmed Atlantic salmon, cod are extremely difficult and expensive to domesticate from the fertilized egg stage through to juveniles ready for commercial grow out (Boyce 2002). Unlike Atlantic salmon that can be fed pellet feeds soon after they consume their yolk sacs, larval cod must be fed live plankton before they can be weaned onto commercial feeds (Boyce 2003). This requires cod hatcheries to raise enriched plankton cultures on site and feed the live cultures to larval cod at precise stages in their development (Boyce 2002). Once cod fry have been weaned off live plankton feeds they must be grown out as juveniles in nurseries before they are ready to be transferred to ocean net pens for commercial farming (NAIA 2002). Furthermore, while cod are in their larval and juvenile stages of development, they display aggressive cannibalistic behaviour that requires extensive monitoring and grading procedures to counteract. As Danny Boyce (2002:31) of the Aquaculture Research Development Facility at Memorial University's Ocean Science Centre notes:

> Cod are very cannibalistic at a young age, for this reason, periodic size grading is important to obtain good survival and yields, and to eliminate runts, which may encourage cannibalistic behavior. Grading is the process of separating the cod into 2-3 different size ranges (simply called small, medium and large). Larvae are closely observed, once they reach 50-60 days of age, for noticeable size differences and for evaluating the percentage of larvae that are undergoing metamorphosis. They are also closely watched for evidence of cannibalism and bullying by larger-sized larvae.

The coastal geography and climate of Newfoundland and Labrador add additional management challenges for full cycle cod grow out. For farmed cod to reach marketable sizes (2-3 kgs) ice free conditions on coastal farm sites are necessary for the entire twenty-four month grow-out period (NAIA 2002). The seasonal ice flows around most of the island restrict the location of full cycle aquaculture sites to a small area of the south coast (*see* Figure 7.1). Ice-free sites along the south coast are limited further due to warm water temperatures during the summer months that can raise water temperatures to levels beyond the tolerance of *Gadus morhua* (Caines 2003).

Management challenges and costs associated with egg-to-plate cod farming mean that cod aquaculture can only be undertaken by large corporations who can achieve economies of scale (NAIA 2002). To be profitable, egg-to-plate cod operations have to sell farmed cod at premium prices into exclusive markets (Sackton 2003). Commercial viability for full cycle cod farms requires "large scale production of approximately 1,000 tons annually; total owner investment of cash and equity of at least $1.25 million; highly skilled farm management and staff with the requisite skills and experience in both business management and aquaculture; and optimal aquaculture site selection based on temperature profile, water flow, and the absence of pack ice" (NAIA 2002:36). Due to the financial risks associated with cod aquaculture "commercial lending agencies have been reluctant to provide loans for aquaculture in Newfoundland and Labrador" (DFA 2002:8). This has meant that the cod aquaculture industry has become highly dependent on support from both the Federal and Provincial governments as well as foreign venture capital. In the years following the cod fisheries moratorium the Federal government's Atlantic Canada Opportunities Agency (ACOA) became the lead agency providing financing to develop an egg-to-plate cod farming industry in the province.

## 7.2 Government Support for Cod Aquaculture: Strengthening Market Managerialism

> My sense of the relationship between ACOA and the aquaculture industry is like that of an old married couple. You get to a point where there is nothing new to say...[However] unlike the old married couple who've been in bed together for so long that there isn't much going on, that is not the case with ACOA and the aquaculture industry. We aren't sure who is doing what to whom in this bed, but there sure is a lot going on. There should be no question in anybody's mind that ACOA has been committed to the aquaculture industry. Over the past 15 years ACOA has invested 164 million dollars in the industry in Atlantic Canada...In Newfoundland...ACOA has invested more than 50 million dollars...And we intend to continue to do that...4.1 million will go to research on cod aquaculture as well as 600,000 to a project that will enhance disease resistance in salmon. This does not count 1.6 million recently invested in the new cod hatchery in Bay Roberts from a number of programs. And the message in all of that is that if it is a good thing for the industry, we will find a way to do it (ACOA official, NAIA 2003).

As indicated in the comments of the ACOA official above, the relationship between the cod aquaculture industry and government has been extremely cozy. In the years following the 1992 moratorium the Federal Department of Fisheries and Oceans released an *Aquaculture Development Strategy* that promised financial support for aquaculture-related infrastructure and the creation of "a regulatory and policy framework conducive to industry development" (DFO 1995b:8). In 1998, the Federal government institutionalized support for aquaculture development by creating a new Commissioner for Aquaculture Development who was mandated to develop policy recommendations and deliver them directly to the Fisheries Minister without having to go through the Department of Fisheries and Oceans bureaucracy.

Federal and Provincial authorities have promoted cod aquaculture aggressively with funding from a specific aquaculture component built into the Canada/Newfoundland Agreement on Economic Renewal and more recently through a new Atlantic innovation fund administered by the Atlantic Canada Opportunities Agency (ACOA). Research and development support has been provided through *AquaNet*, a seven year, $14.4 million aquaculture research network devoted to positioning the Canadian aquaculture industry globally by increasing the efficiency of aquaculture production through species diversification, biotechnology, environmental sustainability, and the training of highly qualified personnel (AquaNet 2004). The province has encouraged aquaculture development by conducting an aquaculture review, completing a study on conflict management in the industry, producing a legislative framework that includes an *Aquaculture Act* with growth-friendly regulations, and a loan guarantee program for aquaculture-related feed purchases.[4]

[4] Feed is one of the most expensive components of full cycle cod and salmon farming accounting for up to 80% of operating costs (CBC 2004b). In the Fall of 2004 the province's largest aquaculture corporation, North Atlantic Sea Farms, was placed into receivership by Shur-Gain, a mainland feed producer that it owed in excess of 3 million dollars for salmon feed extended to them on credit (CBC 2004b). In face of a

The goal for both the cod aquaculture industry and government is to create a modernized intensively managed industrial cod production system along the coast. The emphasis is on increasing the efficiency of wild cod production by domesticating the lifecycle of cod through technological and managerial interventions to achieve maximum single species yields that can compete successfully in global seafood markets. This approach is succinctly illustrated in the Federal government's *Aquaculture Development Strategy*:

> To remain internationally competitive, Canadian producers must sustain the relentless pursuit of technological and management improvements that allow Canada to gain stature in world aquaculture. The capability to produce and market desired products at internationally competitive prices is paramount to sustained development (DFO 1995b:9).

By interpreting sustainability as the maintenance of economic growth in a globally competitive market, the tensions between unlimited production and ecological limits are easily overlooked and obscured. Unlike the wild cod fishery that relied on ecological conditions in the Northwest Atlantic to "produce" cod, industrial farming attempts to artificially create growing conditions and engineer cod biology to produce a commodity that can compete in global seafood markets.

The Federal and Provincial governments' aquaculture management system focuses on single species production, regulating how many sites are to be licensed and where they are located. Unlike ecosystem approaches to fisheries management, the management of cod from egg-to-plate pays little attention to the complex relationships that exist between

---

withdrawal of credit support from the feed company, North Atlantic Sea Farms lobbied the provincial government to create a loan guarantee program for the aquaculture industry. Its sister company, Northern Cod Ventures, also applied pressure to the government threatening to shelve plans to open their cod hatchery and cod grow out operations if the Provincial government did not come up with a feed loan guarantee program (NAIA 2004). The Provincial government responded quickly to the pressure creating a feed loan guarantee program within one month of North Atlantic Sea Farms request. The Provincial feed loan guarantee program effectively transferred the majority of the financial risks associated with cod and salmon farming onto the public while ensuring the viability of privately owned aquaculture operations in the province (CBC 2004c).

activities on aquaculture sites and the larger social, ecological, political, economic and cultural contexts within which they are embedded. Federal and Provincial policy documents treat aquaculture sites as if they were discrete, disconnected objects that can be privatized through leasing arrangements. The *Newfoundland Aquaculture Act* permits the transfer of portions of harbours, bays, and inlets – which were formerly the collective property of the citizenry of Newfoundland and Labrador – into enclosed property, leased to private individuals and corporations (Government of Newfoundland & Labrador 1990). As with other forms of foreshore leasing, this permits the enclosure of coastal space and the privatization of cod populations as swimming inventories.

Technological and managerial interventions that directly affect how fish are cultivated (the intensity of the fish farming activity, the wastes produced, the inputs used, the genetic make-up and species composition of the fish grown, the salaries and organizational abilities of employees, and other internalized business factors) are left primarily to the discretion of individual aquaculture entrepreneurs who are to be guided by the "invisible hand" of competitive markets. Egg-to-plate cod aquaculture reinforces a market managerialist approach to cod reflecting DFO policy changes adopted in the wake of the cod collapse in 1992. Cod aquaculture emphasizes individual ownership and management responsibility for marine resources once under the exclusive purview of the state. The government of Canada's *Aquaculture Development Strategy* is explicit about individual ownership in its definition of aquaculture:

> Aquaculture is the culture of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Culture implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Culture also implies individual or corporate ownership of the stock being cultivated (DFO 1995b:3).

Cod aquaculture extends and intensifies the government's market-oriented management approach to marine fisheries discussed in chapter six. Rather than ownership and property rights being tied to a quota for a portion of the biomass of wild cod populations, ownership and property rights in aquaculture apply to the entire lifecycle of cod and even to patented brood stocks and the genetic code of domesticated fish. The ability to control cod from egg-to-plate subsumes cod biology to the logic and needs of capital. International agreements and institutions such as the North American Free Trade Agreement, the World Trade Organization, and the proposed Free Trade Agreement of the Americas enshrine property rights that enable the privatization and commodification of cultured organisms on the enclosed coastal spaces of fish farms. Once coastal spaces have been privatized, the international trade regime creates the potential for corporations to sue governments to recuperate lost profits should a national or provincial government decide to reclaim coastal zones or coastal genomes as state-owned common property (Public Citizen 2004).

In addition to the loss of common state-managed property, the expanded logic of privatization, commodification and enclosure that underlie industrial cod farming influence changes to the social identity of cod fishers. In the earlier efforts to move Newfoundland and Labrador from a small scale inshore fishery to an intensive offshore dragger fishery, governments and market institutions told fishers that they had to abandon their small boats and detailed local knowledge and embrace the industrial efficiency of big boat technology and scientific fisheries management (*see* chapter four). With aquaculture, fishers are asked to cease being hunters altogether and evolve into professional industrial farmers. This perspective is bluntly stated in a recent article from *The Economist*:

> In fact, [the ocean] is a resource that must be preserved and harvested. To enhance its uses, the water must become ever more like the land, with owners, laws and limits. Fishermen must behave more like ranchers than hunters (Carr 1998:15).

Cod aquaculture leads to the commodification of the coastal zone and requires intensive corporate-led management, a smaller more efficient workforce, higher levels of capitalization, and more complete integration into global seafood markets than the wild cod fishery. Through egg-to-plate farming cod become increasingly conceptualized as a swimming inventory—a pure commodity with exchange value rather than a food source with use value for local people or a living organism with intrinsic existence value. In order to compete with low cost global producers and other white fish products, farmed cod must be branded as a high end product (Sackton 2003). The needs and demands of the global seafood market come to influence everything that occurs on fish farms since "there is very little point in growing seafood if you can't sell it" (Sackton 2003).

Competition in the global seafood market has led to concentration of ownership in the Canadian finfish aquaculture industry (Bailey *et al.* 1996). The well developed BC salmon farming industry, for example, concentrated from 140 start-up operations in the 1980's to a group of 11 corporations by 2003 with high levels of foreign ownership and corporate practices of vertical integration and contract farming (Conley 1998, Marshall 2003)[5]. The business climate created by this concentrated ownership pattern has meant that individual fish farms tend to capture a small percentage of the overall value of their

[5] Marshall (2003:9) notes that "Five multinational companies control 109 of 131 (83 per cent) fish farm licences and generate 82 per cent of total production in the province [of British Columbia]. Four of those companies (Stolt-Nielson, Pan Fish, Nutreco, and Cermaq) are based in Europe while one (George Weston) is Canadian, based in Toronto...Only nine salmon farming tenures (7 per cent of the total) are controlled by companies that are majority-owned by British Columbians."

farmed products (even though they absorb the majority of the economic risks). Most cultivated finfish species such as cod and salmon become "commodities with hyper-competition amongst producers that tends to drive [down] producer prices" (Lockwood 1999:30).

These economic outcomes have important impacts on the distribution of benefits to communities living in coastal zones where industrial aquaculture takes place (Newkirk 1996). In Newfoundland and Labrador, the recent move from small scale wild cod grow out to full cycle cod aquaculture resulted in a dramatic increase in the capital costs and risks associated with cod farming operations. The expense and risk involved in egg-to-plate cod farming means that much of the capital investment for egg-to-plate cod aquaculture has to come from government subsidies, grants and loans; and from capital investments by seafood processors, offshore banks and venture capital funds (DFA 2002). These conditions do not produce a wide distribution of benefits and often generate conflicts. In Newfoundland and Labrador documented conflicts associated with aquaculture include:

- Navigational safety issues involving recreational boating and inshore fisheries;
- Impaired access to the shoreline;
- Aesthetic concerns voiced by home and cabin owners;
- Environmental considerations;
- Aquaculture's impact on access to traditional fishing grounds and perceptions of negative impacts on lucrative wild marine species such as lobster and crab (Government of Newfoundland and Labrador 1998).

## 7.3 Domesticated Fish in a Wild Ecology

> We will domesticate the fish over time…knock them down to a more passive fish…And we'll have fish that will just swim around and graze like a cow...That's what we're all shooting for (NFB 1989).

With these words, a British Columbia salmon farmer succinctly describes the essence of industrial aquaculture. The idea is to establish highly controlled systems that domesticate profitable wild species to produce maximum output while minimizing capital input. Key components can include the use of genetically modified organisms (GMOs), enriched foods, and intensive management (focusing on disease prevention and nutrition for rapid growth). Aquaculture operations favour the most profitable species and harmonize harvest schedules with peak prices and market demand. Profit imperatives discourage attention to ecological and social costs.

Considerable scientific uncertainty and debate swirl around the present and future ecological risks of aquaculture. The ecological systems involved are highly complex; possible effects are at best difficult to predict and scientific certainty is rarely possible. The main ecological concerns raised have centered on:

- escapes (potential genetic, parasitic and disease transmissions to diminished wild stocks as well as increased predation and competition for food, habitat and mates);
- chemicals and therapeutics used on the farm;
- the impact of wastes on fish habitat and ecological communities surrounding aquaculture sites (water quality concerns such as eutrophication, anoxia, and the production of hydrogen sulphide and methane);
- the potential for deleterious effects on marine mammals, birds and other species that are targeted as predatory pests by aquaculturalists; and
- the overall ecological footprint of the system (Davenport *et al.* 2003).

The ecological footprint of industrial aquaculture operations far exceeds that of capture fisheries (Folke *et al.* 1998, Tyedmers 2000, Pauly *et al.* 2001). Rather than removing pressure from wild stocks, industrial aquaculture consumes wild fish in the form of fish meal that is fed to farmed fish. Three to five pounds of wild fish are required to produce one pound of farmed salmon or cod (Belton 2004). When fed to caged fish, feed pellets produce concentrated forms of waste that are continuously dispersed into the surrounding marine environment (Folke and Kautsky 1992).

Feed pellets used in aquaculture combine wild fish, agricultural products and therapeutics that have to be collected from, and transported over, vast terrestrial and marine areas. Canada imports fish meal for use in fish feed and industrial feeds for cattle, chicken and pigs. "Canada's fish and seafood imports in 2003 were $2 billion, almost 35 percent of that volume (and about four percent of the value) were products destined for meal used in livestock and fish feed" (Kohane 2004:38). Fish meal is made largely from small pelagic fish such as sardines, anchovies and herring often caught in southern waters (Naylor *et al.* 2000). As the demand for fish meal increases, human beings and other species who rely on small pelagic fish for food have to compete with the demand for fish meal generated by industrially farmed carnivorous fish such as salmon and cod. Cod farming and other carnivorous fish that are raised through industrial farming practices do not contribute to feeding the world or taking pressure off wild stocks. In fact, "every farm-raised salmon, cod or tuna eaten in the Northern hemisphere represents a fourfold reduction in the fish protein available to the people of the South" (Belton 2004:36) and exacerbates pressure on wild fish stocks worldwide (Naylor *et al.* 2000, Pauley *et al.* 2001).

In addition to these international concerns, for Newfoundland and Labrador communities the most troubling aspect of cod farming is the potential for damage to the remaining wild cod stocks. Fish from aquaculture sites escape from sea-cages that wear out or are torn by predators, storms, currents and ice. The numbers of escaped fish can be large, leading to questions about possible genetic effects on wild stocks, disease transfers to wild populations, changes to ecosystem dynamics and structure, as well as confounding effects on wild stock assessment, restoration and management. This is a significant concern in Newfoundland since the south coast, where the majority of future egg-to-plate cod grow out sites have been licensed, is also the location where remaining cod populations are the most abundant (FRCC 2004b; *see* Figure 7.1).

While little empirical research has been done on the effects of escapees on wild cod populations and their ecosystems, past experiences with the introduction of exotic Atlantic salmon in the Pacific ocean in British Columbia provide grounds for prudence and precaution (Leggatt 2001, Volpe 2001). Selection in natural and cultured environments is radically different. Fish raised in hatcheries and on fish farms are selected for traits that optimize marketability (e.g. faster growth rates and larger body size) rather than the ability to produce viable offspring in the wild. If domesticated cod escape and interact with wild cod it is unknown exactly how the market-oriented engineered traits of farmed codfish and the diseases associated with intense cod production will interact with the traits of dramatically reduced wild cod populations and their disease vulnerabilities (Bavington 2001/2003). A recent report by an expert panel from *The Royal Society of Canada* (2001:156) warns that

> cultured fish will be more likely to have a negative impact on wild fish when the number of escapees potentially interacting with wild fish exceeds the size of the wild fish population(s), particularly when the wild population(s) is itself small relative to some conservation-based metric of population size.

This is particularly significant for Newfoundland and Labrador where the number of codfish cultivated is expected to grow exponentially in the future, while wild cod stocks are at historic lows and have continued to decline since the cod fishing moratorium was announced in 1992. Furthermore, it now seems that the remaining wild stocks are not a single population but a variety of genetically diverse, vulnerable inshore and offshore populations. In a recent paper in the *Journal of Fish Biology,* Ruzzante *et al.* (2000:431) reported DNA research findings that "provide evidence that Atlantic cod *Gadus morhua* inhabiting Gilbert Bay, Labrador are genetically distinguishable from offshore cod on the north-east Newfoundland shelf and from inshore cod in Trinity Bay, Newfoundland." These initial findings are extremely significant for policies aimed at aquaculture and wild stock fisheries management. As Ruzzante *et al.* note, "Harvesting strategies for northern cod should recognize the existence of genetic diversity between inshore and offshore components as well as among coastal components" (2000:431). If escaped farmed cod (or other farmed species) were to interbreed, out-compete, spread diseases or otherwise affect the spawning grounds of wild populations of northern cod, the ability to restore wild stocks and the prospect for sustainable fishing livelihoods in Newfoundland and Labrador could be placed in further jeopardy (Bavington 2001).

In addition to deleterious habitat, genetic and disease interactions, escapees can confound wild stock fisheries management by complicating population estimates. For example, researchers reported that 40 percent of the fish caught in the Faroes wild salmon fishery in 1990 were of farmed origin. They caution,

> When assessing salmon fisheries and wild salmon stocks, it is important to estimate the farmed and ranched component of the catch. If such fish are not accounted for, their presence will result in an overestimation of the catches of wild salmon and the size and status of the wild stock will be obscured (Hannsen *et al.* 1999:205).

For cod fisheries managers, egg-to-plate cod aquaculture only adds to the complexities and increases the uncertainties associated with management. Aquaculture adds new variables, bringing additional data collection and ecological modeling challenges that make fisheries management more difficult and expensive. Given the difficulties that the Department of Fisheries and Oceans has in managing wild cod populations that are less complex, and given the department's current budget constraints, it seems reasonable to argue that cod aquaculture development will only increase the difficulties associated with wild cod fisheries management and recovery.

### 7.4 Full Cycle Cod Aquaculture: Fisheries Management Comes Full Circle

Egg-to-plate cod farming physically embodies the idea of single species fisheries management that was discredited by advocates of ecosystem-based management in the wake of the cod collapse in 1992 (*see* chapter 4 and 5). It is seductive because it promises to simplify fisheries management and deliver control over aspects of fish production, reproduction, marketing and consumption that, in the wild fishery, turned out to be highly complex and beyond managerial control and caretaking.

The development of cod aquaculture in Newfoundland and Labrador has been guided by a desire to compete in global seafood markets through the "relentless pursuit of *technological* and *management* improvements" (DFO 1995b:9). It exemplifies an expanded level of human arrogance by seeking to engineer natural and cultural systems to fit them into the logic of global markets through unending economic growth and managerial control. "The ultimate outcome of this techno-arrogance," says conservation biologist Gary Meffe (1992:354), "is the increasingly intensive and essentially perpetual management of a multitude of species in a world unfit for their natural existence."

# CHAPTER 8

## Managerial Ecology in Newfoundland and Labrador Cod Fisheries: Results and Discussion

This chapter opens with a brief review of the main arguments surrounding managerial ecology in general. This is followed with a discussion of the main findings associated with the specific expression of managerial ecology in the Newfoundland and Labrador cod fisheries. The chapter then concludes with an emphasis on the lessons learned from the managerial responses to the cod collapse, setting up a discussion of alternatives to managerial ecology in chapter nine.

### 8.1 Managerial Ecology: The Dynamics of Control, Caretaking and Coping

> More than any other form of knowing or practice, management is claimed to be absolutely nomadic and universally useful (Parker 2002:5).
>
> ...better management sounds sober [and] neutral, as unopposable as virtue itself (Pollitt 1990:49).

I have argued that managerial ecology, like other forms of managerialism, presents management as a universal necessity, a natural good and neutral tool stripped of specificity. As a way to address this ahistoric universalism I argued that management needs to be historically located. An exploration of management's etymology revealed three dominant meanings spanning control, caretaking and coping. I argued that all three of these meanings need to be understood as being dynamically interconnected and arranged hierarchically. Within this hierarchy the control meaning of management designates the most powerful position with caretaking occupying a middle position and coping the bottom. When used in contemporary natural resource management contexts, the meaning of management shifts back and forth between control, caretaking and coping influencing the tools and targets associated with successful managerial interventions and those individuals and institutions that are considered to be the most effective managers. However, while there is an ever-changing diversity of managerial meanings, theories and practices, management raised to the status of an ideal seems to have strengthened its hold over contemporary responses to environmental issues in advanced industrial societies.

Drawing on the work of Carolyn Merchant (1980) I argued that the dominance of managerial ecology flows from its connections to industrial modernity. Managerial ecology is a modern utilitarian approach to ecology with philosophical roots in the Enlightenment and the modern economic, political and scientific order that began to emerge in 16th and 17th century Europe. I illustrated that as society became increasingly organized around the dictates of the market, and a scientific view of nature gradually replaced organicism, the "value system oriented to nature as a teacher whose ways must be followed and respected" gave way to a system of human values focused on "efficiency and production in the sustained use of nature for human benefit" (Merchant 1980:238). I emphasized that managerial ecology matured during the scientific and industrial revolutions to become the dominant way of framing human-nature relations especially in highly "advanced" industrial societies. I went on to describe the abstract logic and simplified models of society and nature required to create the manageable targets that enable profitable flows of board feet, fish protein and other living resources to be predictably extracted from the land and sea.

Having described the historical emergence and development of managerial ecology and the reductive models of reality it relies on for effectiveness, I shifted my focus onto the problems that have recently been identified with the science, politics and ethics of managerial ecology and the reforms that have been suggested to address them. I outlined how various problems with control and caretaking had been identified within natural resource management and argued that these had the potential to fundamentally undermine managerial ecology. However, upon exploration of how these problems had been addressed by natural resource managers, I concluded that they primarily had been responded to through a managerial rhetoric highlighting coping and adaptation *within* rather than against late industrial eco-social orders and ways of life that continue to require aspects of human and non-human nature to be controlled and carefully used. I noted that many natural resource targets—once identified as easy to control and carefully use—are now seen as complex and unpredictable. Yet, this has not led to the end of management as control and caretaking. Rather, managerial control and caretaking have been transferred onto objects deemed less complex and more determined by causal or statistical laws. These developments, I argued, have manifested themselves in calls to manage human beings rather than wild ecosystems and in ongoing projects of domestication of wild species for the purpose of profitable industrial production.

Furthermore, I noted that changes in natural resource management science, politics and ethics that challenge manageability and emphasize the need for coping have occurred as neo-liberal market managerialism replaces state-led managerialism. Neoliberal market managerialism calls for the deployment of novel tools and techniques to control and carefully use a number of new management targets that often work on and through the freedom of individuals and firms, blurring the separation between managers and the managed. Despite this change in how managerial power operates, it still maintains a belief that solutions ultimately reside in the hands of managers, that better organization is the key to improvement and that problems can be solved merely by exerting more effort and obtaining greater efficiencies within the status quo order of advanced industrial societies.

While I argued that the scaffolding of concepts and assumptions varies considerably among the many alternative forms of natural resource management that have recently been proposed, I identified clear overlap in many of their recommendations and goals. As an example, I illustrated that suggestions to move toward adaptive, participatory and ecosystem-based management coincide with neo-liberal economic approaches that stress the challenges of complexity, conflict, and uncertainty in economic systems. As centralized state-led command and control, bureaucratic rule-following and proceduralism have fallen out of favour across a variety of policy fields; flexibility, coping, experimentation and learning have risen to take their place. However, flexibility, coping, experimentation and learning have continued to maintain the underlying goals of managerial control and caretaking even if confidence in the scale and scope with which they can be achieved has waned.

I argued that participatory management under neo-liberal influence has stressed the importance of using local ecological knowledge and achieving "buy-in" from resource users to achieve consensus, avoid conflict, and permit ongoing economic growth. In practice, opening up management processes to resource users has done little to challenge existing hierarchical power relations or the underlying eco-social order of late industrial societies. The actual politics of participatory natural resource management, despite theoretical proposals to the contrary, have been primarily reformist in character with little democratic deliberation on the ultimate ends of interventions into the natural world or challenges to hierarchical relations of power. The emphasis has been on the development of more effective and efficient means of problem-solving over deliberation on the eco-social order itself. This focus on efficacy has resulted in a narrow utilitarian ethic in natural resource management that treats non-human and human alike exclusively as means, rather than ends, in the goal of attaining greater efficiencies and resource productivities while minimizing fundamental conflicts that have the potential to call into question current eco-social orders.

To summarize, while I discussed a number of innovations in natural resource management and illustrated how they have responded to perceived problems with the underlying science, politics and ethics of management-as-control and caretaking, it was evident that in practice these innovations have often served to strengthen rather than challenge managerial ecology. For example, the recognition of complexity in biophysical systems has led adaptive managers to advocate the management of human activities. Strategies to address expensive and historically oppressive statist natural resource management have led to an emphasis on increased responsibility, autonomy and self-management by individuals, firms and local communities in the context of the increasing dominance of the global economy and transnational corporations. Managerial ecology continues to maintain its strength and expand into new areas by selectively incorporating insights from ecological science, politics and ethics while largely leaving the advanced industrial economy unquestioned.

In this context it is clear that, despite good intentions, a focus on ameliorating mismanagement or managing things that previously fell outside the scope of managerial ecology is counterproductive to the goal of fundamentally questioning managerial ecology in the cod fisheries. Perspectives within natural resource management science, politics and ethics that fundamentally call into question the normative status and practical efficacy of managerial ecology have either been largely ignored or selectively taken up in ways that help to strengthen the current late modern industrial order by framing critique as an opportunity to remedy anomalies within the status quo. Problems that are structural in nature or require the recognition of irreducible uncertainty and complexity in linked eco-social systems are also poorly addressed by managerial solutions that require controllable and predictable objects to manage.

In retrospect, it seems clear that I succumbed in my review of the natural resource management literature to a naïve belief in the power of alternatives to natural resource management coming from critiques that developed within the field. In my defence, this is perhaps not so surprising given Chris Grey's (1996:593) observation that "contemporary forms of managerialism are typically rendered seductive by the deployment of much of the language which was hitherto associated with critique." The challenge, Grey (1996) argues, is to find ways to articulate alternatives in new ways that are less susceptible to co-optation. Exploring the history of the management idea in the cod fisheries in this dissertation was one step that I took in this direction.

## 8.2 Managerial Ecology's History in the Cod Fishery

> Fisheries management is a thoroughly modernist venture, imbued as are so many other of the applied "natural resource" areas with a very pragmatic, utilitarian, science-dependent, and mostly optimistic perspective on the ability of people to "manage" wild things and processes (McCay and Finlayson 1995:1).

While the specifics of the cod case complicate the general history of managerial ecology described above, similar trends were observed. As I detailed in chapter four, up until the middle of the nineteenth century cod fishing in Newfoundland and Labrador was primarily an inshore activity using baited hand lines to catch cod fish. Access to common fishing grounds and fishing rules was regulated through a moral economy embedded in the social relations of small rural outport communities. Under this pre-industrial eco-social order fluctuations in fish landings were accepted as natural, the providence of God. Fluctuating landings were coped with and adapted to through occupational pluralism and a combined reliance on subsistence and mercantile economies that valued cod for its use and exchange values respectively. I do not wish to romanticize this subsistence-mercantile economy. I simply want to point out that managerial ecology in the cod fisheries had no place under this pre-industrial system. This type of pre-modern, pre-managerial coping and adaptation to nature is qualitatively different from managerial coping that refers to adapting as an element in a larger hierarchical system of control and caretaking that is made rather than given in the nature of things. The pre-industrial non-managerial form of coping implied an acceptance of human limits to knowledge of, and control over, human and non-human nature. Coping as a managerial stance, however, refers to a situation where limits are being imposed by some person, institution or system that can in principle be overcome. Since the coping manager is "a subsystem, a creature that functions within an oppressive system" (Esteva *et al.* 2005:23) the underlying goals of control and caretaking remain and are often spurred to new heights rather than being fundamentally questioned and challenged.

Subsequently, the pre-industrial hybrid subsistence-mercantile economy developed into a modern industrial market economy focused on maximizing exchange values through the exploitation of fishery resources and wage labour. I argued in chapter four that it was this shift towards a modern industrial fishery that stimulated the development of managerial ecology in the cod fisheries. During this period, fluctuations in cod landings became a technical problem that needed to be controlled rather than an accepted fact of nature under the providence of God. Industrial technological developments allowed uncertainties associated with accessing fishing grounds to be solved by scaling-up fishing activities spatially and temporally while progressively replacing passive-fixed gears with active-mobile ones. At the same time, the developing market economy and society required the eradication of uncertainties associated with fluctuations in cod landings to ensure the economic value of fishery resources. Fluctuations in landings, therefore, became a problem that had to be managed (controlled and carefully stewarded) in the context of the many changes associated with industrial modernity. It is the problematization of what was previously accepted as a natural given that marks the birth of managerial ecology in the cod fisheries. Following Merchant (1980), it was the death of cod fish and fishing people understood as living subjects (organic and uniquely embedded in a holistic living matrix of complex eco-social relations) and their replacement as inert mechanical objects (statistical populations, possessive individuals and other disconnected elements that could be described and manipulated quantitatively) that permitted the birth of managerial ecology in the cod fisheries.

With the onslaught of market society and industrial modernization a great transformation occurred affecting the way cod, cod fishing, cod fishers and the relationships between them were perceived. Fluctuations in the fishery became a problem to be solved by fisheries scientists and government bureaucrats. Natural cycles of lean and plenty formerly coped with and adapted to by fishing families through occupational pluralism and a precarious balance between subsistence use and market exchange with repeated periods of great hardship (including threats of starvation) gave way to a focus on maximizing exchange values and eventually almost complete dependence on a modern industrialized fishery, growth-oriented state, consumer-oriented society and capitalist market economy.

With industrial modernity came mechanical metaphors of the fishery. Machine metaphors and theories dominated the original phase of managerial ecology in the cod fisheries. Cod became described as products produced by a predictable ocean factory and the paradigmatic fishing person increasingly became the industrial worker laboring on offshore factory trawlers operating mechanized fishing gears and the latest fish finding electronics. Fishery models promoted the view that properly controlled fishing could in turn control the productivity of single species fish populations as if the fish were produced by a predictable organic machine.

Flowing out of the revolutionary changes of industrial modernity, a mechanistic understanding of fish, fishing and fishers was developed by fisheries scientists starting around the middle of the nineteenth century. Successive governments created a special relationship with fisheries scientists, asking them to solve the fluctuation problem. For fisheries scientists to provide the answers demanded by governments, I described how naturalism in fisheries biology gave way to modern science. The search for universal laws that would permit quantification, prediction and control over the objects of study, rather than the rich qualitative descriptions of naturalists which were aimed at general understanding, represented a major shift in fisheries biology—one that put the knowledge of fish into a new relationship with managerial power. When fully formed, scientific representations of the fishery permitted centrally located managers to believe they could predictably control the productivity of fish stocks by regulating fishing as if they were controlling outputs from a factory by regulating machinery and human resources (wage laborers).

In chapter four, I emphasized how the development of population thinking in fisheries biology was crucial to the emergence of fisheries biology as a modern scientific discipline that could provide knowledge to serve the interests of managerial power. Modern fisheries science claimed to discover natural laws that controlled fish landing fluctuations and—more importantly—explained how fishing could be used to control these fluctuations and maximize the productivity of fish stocks. When connected with economic laws that purported to describe human behaviour, biologists and economists developed representations of the fishery that offered governments not only a solution to fluctuating landings but also a blueprint for how to develop the cod fishery as if it were a modern industrial sector. Institutions, economic relations, and social structures developed that relied on the knowledge and power regime of managerial ecology and built up substantial institutional inertia to any fundamental change in this arrangement (Finlayson 1994, Bella 1997). The construction of manageability in the cod fisheries was a crucial component of the new industrial fishing society that saw fishing emerge as an industry. The modernization of fishing technology and the simplified representations of fish and fishing from scientists mutually supported the emergence of a modern industrial fishing society in Newfoundland and Labrador.

The scientific representation of fish as single species statistical populations that could be controlled through the careful calibration of fishing related mortalities led to demands for state ownership of most of the continental shelf out 200 nautical miles from shore to avoid the tragedy of the commons. The need for this expansion of state territorial power was triggered by the development and arrival of technologically sophisticated industrial fishing vessels on offshore fishing banks after WWII. The arrival of these efficient fish killing machines exposed cod to continuous fishing pressure from fishing nations around the globe at a scale that up to that time had never been imagined. Ownership of the stock by the Canadian state acting as a careful manager rather than a ban on the industrial fishing technology was the solution that was implemented. Once enclosed as state property it was assumed that representations from fisheries science and interventions from a strong state could rebuild and maintain cod stocks at levels allowing Canadian industrial fishing practices that were to far exceed historical fishing capacity and annual fish landings[1].

Before the parallel birth of industrial modernization and managerial ecology in the cod fishery, the act of fishing and the fishers themselves were integrated and there was no distinction between fishing and a separate higher level function of control over, or husbandry of, the fishing process. There was no need for the fishery as a whole to be coordinated beyond adjacent community waters. The arrival of industrial fishing technologies changed this dynamic. Without a ban on this technology all that was left was to attempt to develop a form of power commensurate with the revolutionary scale of the technology. Managerial ecology and the power associated with it flourished in this

[1] As discussed in chapter four, by 1982 after the extension of Canada's nation jurisdiction out to 200 miles, the Department of Fisheries and Oceans claimed that cod fisheries management was working, the rebuilding process was well under way and they predicted a long term sustainable yield of 550,000 metric tons (Kirby 1983). This number was never reached under DFO management and represented a projection of landings that was close to two times the size of the long term historical average catches that averaged from 150,000 – 300,000 up to the 1950's when the factory freezer trawlers arrived on the banks (McCay and Finlayson 1995).

context, and became a pivotal component of the industrial fishery. Constructing cod and the fishery as manageable objects allowed a modern way of life and eco-social order to develop along the coast of Newfoundland and Labrador. Like the mercantile-subsistence order and way of living before it, the modern order and way of living with cod was extremely precarious. Unlike the mercantile-subsistence way of life, however, the modern arrangement had irrevocably devastating consequences for wild codfish and an entire way of life based on hunting them.

## 8.3 Cod Collapse Crisis and Reformed Managerial Ecology

> [This] reminds me of an accusation once leveled by a fisherman to the effect that "you're all", academics and bureaucrats, I presumed, "a bunch of farmers". Given the circumstances, I don't think the gentleman meant to imply we were all basically hicks. What was meant was that in trying to solve the fishery problem (in fact, to define the problem), we do so by attempting to control or domesticate the fish (and maybe the fisherman) (Wilson 1988:274).

> The scientific discourse that has guided fisheries management in Canada is being replaced by a neo-liberal discourse that underscores free-market capitalism. Like the scientific discourse, however, it derives power from its exclusionary processes that define experts and non-experts. In the paradigm that currently dominates the state's plans for the restructured fishery and its participants, the experts are economists [who now dominate] instead of [natural] scientists (Power 2005:127).

The collapse of the cod stocks was a massive ecological and social disaster that could have significantly undermined managerial ecology and spawned new ways of living with cod. This did not happen. Rather, the collapse produced a renewed managerial ecology providing fertile soil for the promotion of a variety of new managerial approaches that framed the collapse as a functional challenge to be met with new and improved techniques within a late modern way of life. Understanding this response is crucial for alternatives to managerial ecology in the cod fisheries to have a chance of emerging. Critical insights from the natural and social sciences as well as the experiences and opinions of fishing people themselves were put to work for science and management in the years following the 1992 moratorium, as state-led managerialism gave way to market managerialism. Indeed, comments by Peter Sinclair (1988:174) on the character of fisheries policy before the cod collapse continued to be mirrored in responses after 1992.

> The overall aim of fisheries policy, both federal and provincial, has been to promote orderly growth and reduce social conflict in the industry without changing the institutional structure any more than necessary.

Despite the overall status quo industrial nature of fisheries policy after the collapse, there were major changes in the character of cod fisheries management that became clear during my research. These changes signaled a development of industrial modernity from a high modern to a late modern stage. First, there were developments within natural science that promoted the view that wild cod were increasingly difficult to manage. This resulted in less confident forms of management calling for an adaptive and precautionary approach emphasizing management-as-coping. While appearing to share similarities with the pre-industrial, pre-modern adaptive and coping stance of inshore fishing communities, management-as-coping remained thoroughly embedded within industrial modernity and its associated managerialism. Second, there were developments that could be characterized as flowing from the social sciences. These emphasized the need to include fishers in science and management to achieve effectiveness. This resulted in fishing people and enterprises becoming the primary targets for managerial interventions that sought to internalize management-as-control. Third, there were developments that touched on environmental ethics and the distinction between wild and domesticated animals. Wild cod were domesticated as a farm animal and a rhetoric of stewardship and husbandry emerged that emphasized management-as-caretaking as cod became private property owned throughout their entire lifecycle. This final development was linked to changes in the Canadian economy from mass produced goods to niche products and moves toward a "post-industrial" economy emphasizing biotechnology and information processing industries.

While motivated by a desire to understand cod as embedded in larger biophysical contexts, the switch in emphasis from management-as-control to coping with respect to wild cod was applied in extremely narrow and selective ways that maintained an overall managerial approach. The inability to manage many of the biophysical variables affecting cod populations was recognized by the Department of Fisheries and Oceans. However, attempts to create management systems that could slowly (re)gain competence in predicting changes in wild-stocks of commercially valuable species continued over time. A holding pattern emerged where faith continued to be placed in future developments that would allow greater prediction and control, this time of multiple species and whole ecosystems. While tempered by massive cuts to fisheries science and management budgets after the moratorium, faith in the normal science behind managerial ecology seems not to have suffered a significant blow from the cod collapse. As McCay and Finlayson (1995:10) noted the collapse of the cod stock was not accompanied by a "parallel collapse of the paradigm of science-based fisheries management and its supported institutional structures, processes and relationships." Instead, what collapsed along with the cod stock was "the social structure of the fishery to the extent that it was dependent on the northern cod" (McCay and Finlayson 1995:10). The collapsed social structure strengthened conditions that helped to encourage a new round of internalized managerial control as fishing people became less oriented to family and community commitments and embraced possessive individualism.

With the management-as-coping stance applied to wild cod, this has not fundamentally challenged the social and political authority of "normal" modern science as the foundation of knowledge in the fishery. The cod collapse did challenge the scientific representation of wild cod as primarily offshore single species populations cut off from interactions with inshore cod populations, other species and biophysical conditions. Management-as-coping was suggested as a response to deal with the wild cod populations that are left and managerial control and caretaking have been relocated onto new targets using new means.

Managerial interventions in the cod fishery now work by involving, rather than excluding, fishers once they have been licensed and achieve "bona fide" professional fish harvester status. Management now operates on the identity of fishing people—attempting to turn them into the scientists, (self-)managers and rational economic actors assumed in the original bio-economic fisheries management models. Criticisms of fisheries science and management made by fishers before the 1992 collapse have been responded to by integrating narrow slices of their local ecological knowledge into normal scientific and managerial procedures simply as an additional source of data.

Political challenges to managerial legitimacy and calls for democratic versus managerial rule in the fishery have been filtered through a market managerial lens. Market managerialism has promoted the idea that the fishery problem is that too many non-professionalized fishers were chasing too few fish. The solution has been to remove many fishers from the fishery altogether and to require mandatory training and industry self-management from a core group of professional fish harvesters. The fishers who remain must take on management tasks once the exclusive purview of state-based fisheries managers. What fisheries managers once did to the fishing industry, the fishing industry now increasingly does to itself. This project aimed at producing self-managing professional fish harvesters is based on a simplified caricature of fishing and fishing people and reflects the assumptions of single species management models. As the opening quote from Wilson (1988) suggests, this managerial approach reflects a modern domesticated versus pre-modern wild view of fishing people and fish respectively. These economic models assume that fishers' behaviour is "determined" or "behaviourized" by economically rational calculations and morality tied to private ownership of fisheries resources and assume that wild fish can, and must, be turned into alienable property to insure their conservation.

The rise of private ownership over marine resources as a solution to the over-fishing of wild cod also forms a central finding of my research. While the Western North Atlantic ocean's reproduction of wild cod continued to suffer declines after the fishing moratorium (leading to fears of biological as well as commercial extinction), cod (re)production has largely been taken up by a burgeoning fish farming industry. On farms, the abstract single species populations described in fisheries management models as predictable swimming inventories became a reality. Connections between control, private ownership, and management-as-caretaking also became clear through this development. Aquaculture appeared to solve the ongoing economic problem of open access and lack of secure stock ownership long bemoaned by fisheries economists. Farming permits the emergence of privately owned cod stocks that can be husbanded and carefully used according to the wishes of private owners and their appointed stewards. In terms of the language used, cod management in aquaculture takes on a soft civilized custodial air with images of caring for cod replacing those of barbaric cod hunting and killing. As discussed in chapter seven, however, the pastoral rhetoric of cod farming masks many new ecological and social equity problems that are raised by industrial farming. Industrial fish farming also perpetuates an understanding of cod as a commodity with exchange value and cod "fishing" as an activity geared exclusively toward the production of fish for the market as opposed to restorative models of fishing and aquaculture that are geared toward wild cod capture-grow-and-release (Bavington 2003b).

The above developments illustrate a new phase of managerial ecology that has emerged since the cod collapse in 1992. Rather than assuming that the conditions for manageability exist in the nature of cod and fishing people (as natural laws passively awaiting discovery by scientists) manageability is now increasingly conceptualized as a condition that must be created, consciously designed and engineered into the very nature of cod and fishing people. To achieve managerial effectiveness in the face of failure, cod fisheries management has tried to create what the simplified management models had previously taken for granted as existing in nature: single species populations of cod cut off from their supportive ecological context and disembedded entrepreneurial fish harvesters behaving as rational economic actors. The increasingly technological nature of fishing and the concentrated ownership of fisheries resources accompanying the explosive rise of the crab fishery since the cod collapse and corresponding ecological regime shift have helped to encourage this new stage of managerial ecology. The post-92 fishery in Newfoundland and Labrador is one where the entrepreneurial character of fishing is emphasized. To go fishing, fish harvesters must now take on large debts to purchase a boat, licence, fishing and monitoring technologies that are required legally to access fishing grounds and be able to participate profitably in an area once available to all for subsistence and livelihood activities. The failure of one mode of managerial ecology in the cod fisheries has provoked the intensification rather than retreat of managerialism. The emergence of coping language with respect to wild cod occurs in the context of the expansion of control and caretaking into new areas and does not represent a similar stance to that of the pre-industrial period or a revolutionary change in worldview away from mechanism toward organicism.

The new stage of managerial ecology in the cod fisheries has failed to take into account many of the insights developed by natural and social scientists who have studied the cod fishery collapse and the experiences and opinions of fishing people themselves. By selectively recognizing ecological complexity in wild ecosystems that have become commercially annihilated while simplifying complexity in society and on the fish farm, the insights and implications flowing from post-normal science and the ecosystem approach (that have the potential to challenge fundamentally the whole idea of manageability) have been significantly tamed. By seeking to incorporate local ecological knowledge of fishers into fisheries science and management, insights into the political nature of power and interests associated with fisheries science and management and the incommensurability between what fishers experience on the water and the advice flowing from abstract fisheries models has been largely overlooked. By framing demands for democratic deliberation and decision making in the cod fishery as calls for industrial self-management, political insights around the oppressive nature of managerial power and the need for more equitable-communicative versus expert-instrumental rationality have been obscured. The project of industrial domestication of cod on farms increases the utilitarian approach to cod seeing them solely as a commodity sidelining discussions around the intrinsic value and ecological integrity of cod as a wild species. Industrial farming also increases the technological intensity and cost of "fishing," transforming a hunting activity embedded in a technologically mediated, but ultimately wild ocean, into a fully controlled harvesting operation.

All of these developments make it difficult to think and act beyond managerial ecology in the cod fisheries. Despite all of the changes in the means of obtaining control and caretaking, and the explicit recognition of the need to cope with wild cod, management as a practice and ideal aimed at controlling and stewarding fish and people to permit ongoing (post)industrial economic growth remains dominant and appears beyond reproach. Now that the complexity of managerial ecology in the cod fisheries of Newfoundland and Labrador has been more clearly articulated, the challenge is to explore and present alternatives that will not become co-opted as yet another round of managerialism with hierarchical arrangements of control, caretaking and coping. The next chapter explores a few possible paths to these alternatives beginning with a focus on the role complex ecosystem science might play in this project.

# CHAPTER 9

## Toward Alternatives to Managerial Ecology in Newfoundland and Labrador Cod Fisheries: Conclusions and Future Research Directions

> So much management theory and practice is tunnel-visioned and dangerous—practically as well as intellectually, ecologically as well as culturally (Alvesson and Wilmott 2003:11).

> Fisheries management is enormously controversial and political, and often seems to be a struggle in futility (Rosenberg 2003:103).

This concluding chapter presents a preliminary discussion of the difficult questions that invariably come to the fore when trying to formulate alternatives to managerial ecology. It argues that the first step in moving beyond managerial ecology is to abandon the search for new managerial theories and techniques that promise to deliver manageability. In moving toward an alternative, the chapter explores the potential of complex ecosystem science in highlighting the limits of manageability and pointing toward the need to learn how to live within eco-social systems without trying to manage them. In the case of the Newfoundland and Labrador cod fisheries, turning away from managerial problem-solving will require an explicit acknowledgement of the role of power in shaping managerial representations and the need for a truly democratic politics. It will also necessitate a willingness to entertain questions of social and ecological justice and new conceptions of "the good" that have been heretofore obscured by the hegemony of managerial ecology. The next section explores the possibilities for re-framing capture and culture cod fisheries in ways that avoid the search for "technical" solutions, and instead allow for more explicit deliberation on political and moral issues associated with the cod fisheries. The chapter concludes by suggesting some of the additional research that will be needed in order to articulate alternatives to managerial ecology more clearly.

## 9.1 It's Fine to Say this Stuff but How Can we Fix It?

> It's fine to say this stuff but what we need to do is find out how we can fix this. Can we fix this situation and still keep you on the water? That's the question we have to answer. We have been charged with that task, and we need your help. We need some concrete solutions...That's the challenge we face and we bring to you, because you people are the front line of this. We understand that. But it is not going to do anybody any good to just sit and watch what's left of the Northern cod decline further and further. There will be no fishery left for anybody, so we've got to find a way to reduce the mortality [of cod]. And if there are ways we can do that by keeping you on the water we'd be more than happy to do it. That would be the preferred option. But if it isn't an option, then it isn't an option. So please let me hear, let everyone here on the FRCC hear concrete ways that we can do that, if that's what you believe should be done (*FRCC official responding to concerns by fishers that the cod fishery was going to be permanently shut down by the Federal Fisheries Minister in the Spring of 2003*, FRCC 2003a).

What should be done? What are the alternatives to managerial ecology in the cod fisheries? As the above comments of the FRCC official illustrate, "fixing" problems related to cod fisheries management is an extremely difficult task. If my research into managerial ecology has taught me anything, it is that tragic unintended consequences have often accompanied the actions of managers intent on fixing problems, even those that appeared self-evident. John Ralston Saul warns that "in a civilization [like ours] that has mistaken management techniques for moral values, all answers are a trap" (1992:582).

Given these seemingly insurmountable challenges, how should one approach the question of alternatives to managerial ecology? Chris Grey argues that since contemporary civilization is dominated by multiple forms of managerialism, the only sure way to avoid proposed solutions becoming part of the problem is to stop the project of reforming management and "renounce the search for the holy grail of manageability" (1996:605). As I argued in chapters three and five, new forms of ecological science, politics and ethics hold out the promise of debunking the quest for manageability by pointing out practical and normative limits to control and caretaking in complex, self-organizing, adaptive systems, like cod fisheries. However, I have also shown that in practice, complex ecosystem science has either been interpreted as a weak critique of manageability or has resulted in the transfer of control and caretaking onto new targets—most notably fishing people and cod—that have been domesticated. Furthermore, as discussed in chapter three, changes in natural resource management politics and ethics have focused on the manufacture of consent and decreasing conflict within the existing order through new forms of power that maintain the hierarchical division between managers and the managed, humans and nature. Even when the anti-democratic hierarchy of universal scientific truth and instrumental control and caretaking has been challenged the dominant response has been to enhance scientific truth by incorporating other forms of knowledge (such as LEK) or relying on self-control through incentives tied to private property interests. Both of these approaches fail to provide alternatives to managerial ecology.

What would happen if complex systems science, democratic politics and environmental ethics were taken more seriously? What if pressures placed on ecosystem scientists to "set out simple and clear rules for proper ecosystem management" (Kay and Schneider 1994:32) were removed? If this were done, perhaps it would become possible to formulate an alternative to managerial ecology, based on a renunciation of the futile search for manageability and the emergence of spaces for democratic, non-anthropocentric human-nature relations. This approach might transcend the reform approach of managerial ecology and present an alternative that would foreground non-managerial coping as a new stance toward the world that dispenses with the desire to control and steward nature. In the remainder of this chapter I will explore the potential of this approach to provide a glimpse of possible alternatives to managerial ecology in the cod fisheries by focusing on challenges to both the efficacy and legitimacy of managerial ecology.

### 9.2 Complex Ecosystems Science: Reformed Managerial Ecology or a Radical Alternative?

> Ecologists have been subjected to a long standing pressure from the productive needs of agriculture, forestry, fisheries and game management (Haila 1998:472).
>
> Can we accept that we are always formally in error in our assessments of states of complex, open-ended systems—but in an unknown direction and magnitude? (Finlayson *quoted in* Ben-Yami 2004: 3).

As described in earlier chapters, complex ecosystem science points toward a number of changes in eco-social relations. In adaptive and ecosystem-based management, for example, anthropocentric exogenous control over eco-social systems is abandoned in favour of ongoing experimental learning from within the system—coping replaces control and caretaking as the underlying goal of management. However, as Anderies points out, in the vast majority of cases "[t]his approach still emphasizes 'management' in the sense that the goal is, through active experimentation with the system, to progressively [re]learn to manage a given resource base" (2000:16). In these cases, the complexity of eco-social systems is interpreted as a functional, epistemological problem that will ultimately be solved through new and improved techniques that will eventually deliver control over the whole eco-social system or at least over critical system elements and relations (Bavington 2002). The coping stance in ecosystem-based and adaptive management is managerial because it attempts to regain lost control and caretaking rather than accepting coping as a new way of interacting with the natural world. Science, politics and ethics maintain their focus on control and caretaking even if the means to achieve these goals change. This reformed managerial approach is clearly exhibited in the Food and Agriculture Organization's recent report on world fisheries where they argue:

> Monitoring and diagnosis of the state of stocks and elaboration of management advice will continue to be blurred by exacerbated natural oscillations and climate change. Management systems will become increasingly competent in predicting change over time but, except in a few leading countries, the industry does not seem to be developing the type of responsiveness needed to adjust to systematic forecasts. As a consequence, until the ability to tune fishing capacity and removals to an oscillating environment is acquired, a proportion of stocks is bound to be accidentally overfished at all times unless management systems become highly precautionary – which represents a costly and unlikely scenario, at least in the coming decade (FAO 2004:143).

While the FAO report, quoted above, recognizes the existence of natural fluctuations and change, it maintains a functional epistemological understanding of complex ecological conditions that is reductionist, anti-democratic and anthropocentric. It retains the modernist faith that fisheries science can and ought to predict changes in wild stock abundance and argues that the fishing industry must learn how to "adjust to systematic forecasts" (FAO 2004:143). Fisheries problems are seen as originating through the inability of managers to control the human side of the equation to come in line with predictive scientific assessments. This interpretation of complexity avoids the difficult political and normative questions that are raised by post-normal complex systems science. Fluctuations, oscillations and other complex phenomena associated with the ocean become constructed as problems that can be solved through better anticipatory scientific knowledge and more powerful managerial interventions. This is quite different from ontological interpretations of complex phenomena that understand ecological complexity as a reflection of an underlying natural order that is, in principle, not fully knowable, predictable, or controllable. This ontological complexity represents a new understanding of nature that comes closer to the organicism of the pre-modern period before the advent of managerial ecology.

Just as the emergence of coping within natural resource management discourse has not automatically spelled the end of managerial ecology, the recognition of ecological complexity in the marine environment and the rise of complex ecosystem science in general has not automatically produced an alternative to the mechanistic view of nature with its associated reductionism, anthropocentrism, control and caretaking orientation toward nature. Rather, as Wolfgang Sachs argues, in an early philosophical critique of ecosystem theory:

> Ecosystems theory, based in cybernetics as the science of engineering feedback mechanisms, represents anything but a break with the ominous Western tradition of increasing control over nature. How can a theory of regulation be separated from an interest in manipulation? After all, systems theory aims at control of the second order; it strives for controlling (self)-control. As is obvious, the metaphor underlying systems thinking is the self-governing machine, i.e. a machine capable of adjusting its performance to changing conditions according to preset rules. Whatever the object being observed, be it a factory, a family or a lake, attention focuses on the regulating mechanisms by which the system in question responds to changes in its environment. Once identified, the way is open to condition these mechanisms so as to alter the responsiveness of the system. Today, however, the responsiveness of nature has been strained to the uttermost under the pressures of modern man [*sic*]. Looking at nature in terms of self-regulating systems, therefore, implies either the intention to gauge nature's overload capacity or the aim of adjusting her feedback mechanisms through human intervention. Both strategies amount to completing Bacon's vision of dominating nature, albeit with the added pretension of manipulating her revenge (1992:32).

A more recent critique of ecosystem science by Bruno Latour (2004:131) emphasizes the political implications of the ecosystem concept and the failure of the term to democratically transcend anthropomorphism:

> In supposing that they had surpassed the old limits of anthropomorphism because they were integrating nature and society, users of the term "ecosystem" were retaining modernism's most basic defect, its penchant for composing the whole without the explicit will of those humans and nonhumans who find themselves gathered, collected, or composed in it. They had even found a way to array all beings, humans and nonhumans alike, under the notion of "global ecosystem," in a totality constituted outside the political world, in the nature of things. The ecosystem integrated everything, but too quickly and too cheaply. The Science of ecosystems allowed us to dispense with the requirements of discussion and due process in building the common world: obviously a capital failing in a

> democracy. Science pursued its ravages in philosophy itself, which purported to be putting an end to them. Eco-logical perhaps, but not "eco-politically" correct.

A similar political critique of the ecosystem concept is offered by Bocking (2004:98) who points out that because the ecosystem concept originated as a strictly scientific concept it has continued to imply "a dominant role for scientists in both understanding nature and determining appropriate conduct." By adopting goals such as resilience and "other attributes of ecosystems not readily perceptible by non-scientists" scientists continue to maintain a hierarchical relationship relative to non-scientists that permits the type of relationship among knowledge and intervention typical of managerial ecology (Bocking 2004:98). As Bocking (2004:98) observes, within this context "other people may be included in the process, but [only] as objects to be studied, managed and occasionally consulted, not as decision makers."

As a way to avoid the problems outlined above by Sachs (1993), Latour (2004) and Bocking (2004) it is helpful to understand the human-nature relationship "not as a problem of humans learning how to manage a system, but rather of learning how to live within it" (Anderies 2000:17). In this interpretation, the complexity of ecosystems is taken as a fundamental reflection of the way the world actually is constituted, an ontological fact that demands learning how to live in the world as an equal participant as opposed to seeking to control or steward it from the outside as a manager. Complexity and the coping stance associated with it are not understood as a result of limited knowledge that can ultimately be remedied through further study or better information gathering. A non-managerial understanding of coping comes to the fore here since coping is accepted as the most appropriate response to a complex world, not a condition that demands transcendence. In this way, interpreting complexity as an ontological claim about reality demands a fundamental rethinking of how we relate to human and biophysical nature. As Finlayson (*quoted in* Ben-Yami 2004:3) argues, it involves accepting that "we are always formally in error in our assessments of states of complex, open-ended systems" and this error is "in an unknown direction and magnitude" requiring a fundamentally new mode of interaction with human and biophysical nature to that of managerial ecology. Articulating a similar position James Kay (2002:3) has argued that the challenge of complexity "is to acknowledge the limits of our ability to know [and] to design decision/intervention processes which can learn from both the positive and negative consequences of our limitations and which redress those who are the victims of these consequences." When this approach to complexity is taken all decisions and interventions become "as much about humility, justice, compassion and learning as about "good science", rationality, and profit" (Kay 2002:3-4). These words coming from a post-normal scientist point in radical new directions and raise a host of new problems outside the managerial focus on control and caretaking. They transcend management-as-coping and endless managerial reform by raising political and ethical questions that "imply new complexities for the relations between science and politics: determining how nature will be understood, who has the authority to determine what counts as knowledge, and who is permitted to make decisions on the basis of this knowledge" (Bocking 2004:99).

Indeed, an ontological view of complex ecosystem science can challenge the control oriented hubris and anti-democratic characteristics of modernity itself by forcing a fundamental questioning of manageability. For as Bauman notes:

> Modernity prides itself on the *fragmentation* of the world as its foremost achievement. Fragmentation is the prime source of its strength. The world that falls apart into a plethora of problems is a manageable world...[and] since...problems are manageable—

> the question of the manageability of the world may never appear on the agenda, or at least be infinitely postponed (1991:12).

I have shown throughout this dissertation that managerial ecology was born of industrial modernity and continues to co-evolve with it. By explicitly challenging the reductionism of modern science and proposing a new post-normal relational understanding of nature, complex ecosystem science has the potential to call into question manageability. As discussed in chapter five, by challenging reductionism and raising the spectre of irreducible uncertainty and relationality in scientific knowledge, complexity undermines the ability and authority of scientists to provide universal representations of nature that permit management to take place. This allows democratic political processes as opposed to objective problem-solving exercises to become the new central goal. Once the ability and authority of science to deliver effective management solutions have been undermined, scientific representations of nature can become one opinion among many that can enter the political realm where debate and deliberation, as opposed to hierarchical command and obedience become the focus.

These questions imply a need to learn how to live within complex eco-social systems, as opposed to how to manage them, pointing towards inescapably political and normative issues, which require much deliberation. Learning how to live with eco-social systems means recognizing that there can be no externally formulated objective solution or calculation that can achieve a universally acceptable outcome beyond the normative political sphere, akin to that arrived at through a finite math problem. Ontological complexity obliterates the certainty of "objective" scientific solutions, freeing up possibilities for discussion and the possibility of conflict over opinions, norms and values rather than straightforward consensus based on the facts. This is the exact opposite of the understanding of knowledge that dominates under industrial modernity. In the latter case, increased understanding leads to the identification of causal levers and laws that can be manipulated and used to achieve predictable outcomes—thereby setting the conditions for bargaining, quantitative trade-offs and consensus-based decisions among interested stakeholders versus contextual deliberation among citizens striving to define and co-create a common good.

With respect to the cod fisheries, the above ideas emphasize the need for processes of deliberation and normative debate over what ought to constitute a "good life" with respect to the relationships between cod, people and their supporting eco-social contexts and how people ought to go about learning how to live in an ontologically complex world that may not be able to include cod fishing as a livelihood option. In the cod fisheries case these contextual discussions will have to address the appropriate scale of cod fisheries and raise the issue of the underlying goals for recovery. Presently, the boundaries of what constitutes cod recovery, what cod ought to be saved for, and what cod fisheries ought to be permitted are hotly contested. Rather than a focus on offshore stocks many advocate a bay-level focus that can include discussions around the food versus commercial fisheries and the role of fishing and aquaculture in restoration. Scaling deliberations on the cod fishery to local bays as opposed to NAFO management boundaries might fit better with cultural patterns (identity and accents in Newfoundland are often associated with the bay a person is from) as well as different stocks of cod, the diversity of which has increasingly been officially recognized by fisheries scientists.

This rescaling and refining of fisheries issues to the bay scale and into the political versus managerial sphere will be challenging due to the lack of political representation at this level or institutions arranged in this spatial pattern. However, in the last year of my research it was interesting to see a move among participants of the Fisheries Resource Conservation Council meetings begin to articulate the need for a food fishery over commercial interests that had formed a dividing line at previous meetings. Food fishery discussions were accompanied by calls for a restorative verses exploitative relationship to cod including an active role for fishing people in the restoration.

## 9.3 Democratic Political Ecology versus Managerial Ecology

> "To the famous question "What Is to Be Done?" there is only one answer: Political ecology!" (Latour 2004:235).

> There are a lot of things here that are way beyond our control… The one thing we are in control of is the fella at the bottom of the ladder (Inshore fisher, FRCC 2002a)

Political ecology asks questions surrounding power, struggle, justice and resistance versus how to solve problems associated with control or caretaking. Knowledge and its connection to power is a particularly important part of political ecology as are struggles over what gets constructed as manageable and what is deemed unmanageably complex. From the perspective of political ecology, the struggles of inshore fishers against the knowledge and actions of cod fisheries scientists and managers becomes something that can be seen as constitutive of a political stance as opposed to a problem to be solved through better managerial technique. Struggles over the status of cod reveal incompatible scales of analysis between different types of fishers deploying different gears and between scientists, managers and fishing people. Furthermore, assumptions of what cod should be captured for—profit or personal consumption—raise the question of goals that underlie relationships between cod and people at this moment of history. Up to now these discussions have not been given a space to appear in public.

The Federal Fisheries Minister continues to monopolize decision making authority on issues related to marine fisheries and the goal of maximizing economic growth continues to guide policy. As Ray Rogers has argued with respect to the east coast fisheries crisis:

> If the current goal of development is to pump surplus labour out of humans and surplus resources out of nature through processes which increasingly privatize political power in the economy, the goal of conservation requires a social project which extricates humans and nature from this disenfranchised position, and gains access to the buried politics of the economy, so that it becomes possible to establish public care in viable social terms (1999:5).

The "buried politics of the economy" are perhaps most clearly and consistently raised in the Newfoundland and Labrador cod fisheries in discussions over the political character of fishing technologies. Debates over fishing technologies have played an ongoing role in cod and other fisheries since the emergence of industrial fishing technologies in the 19th century. At that time, the debate in Newfoundland and Labrador was primarily framed by governments as being about the equitable juridical ownership of fishing tools and the fish themselves. Industrial fishing tools would be put within the reach of everyone through loans and grants while fish would be allocated based on scientifically determined total allowable catches and quotas. These managerial solutions dodged difficult questions surrounding industrial fishing technologies raised by inshore small boat fishers. They claimed that industrial fishing gears threatened both the ecology of the fish and the equitable distribution of the cod that were landed, since some fishing gears made it impossible for others to operate and permitted the capture of fish when they were spawning or after they had been satiated and would not go for bait. Once industrial fishing technologies were permitted to enter the fishery, discussions about how to fish began to focus on how many fish were available to be caught, who should own them, and how it would be possible for more people to gain access to new industrial fishing tools.

Debates about the appropriate relationship between people and cod were transformed into problems that could, at least in theory, be solved through technical interventions.

In the early debates around cod fishing technology that took place in the 19th century, the question of how cod were being killed was understood to have significant political dimensions—affecting the very character of the fish (their behaviour and the number of breeders)—as well as equitable social relations in outport communities (Cadigan 1999ab, 2003). Debates around fishing technologies continue to be politicized in Newfoundland and Labrador. A significant number of small-boat inshore fishers have begun to call for a focus on how fishing is done and a return to the baited hook and hand-line gear-type to ensure an equitable, as well as ecologically viable, cod fishery given the current state of the of the stocks (FRCC 2003a). As one inshore fisher noted at an FRCC meeting in 2003:

> ...killing fish that's what I do for a living. And do it quite proudly too. But we've got the technology developed now that we can catch the last one that's out there...We have developed and become very very efficient at killing fish...But we started off with the hook and the line (Inshore cod fisherman, FRCC 2003a).

Greater attention to arguments about how fishing is done, as opposed to how many fish can be removed from the ocean, must be pursued in future fisheries research. Local environmental groups such as the Fisheries Recovery Action Committee (FRAC) and fishing co-operatives such as the Petty Harbour co-op have started to raise the issue of fishing technology again at meetings and in the media. A thorough exploration of fishing and aquaculture technologies is needed if we are to move away from an approach that seeks to manage marine species and whole ecosystems. In the current context, however, it is difficult for fishing people and others to deliberate on how fishing is done because of the monetary and knowledge investments that have been made in highly efficient industrial gear types. In order to move beyond the need for predictive science and the simplifications of ecosystems that necessarily accompany it, fishing technology will have to be conceived of differently. It will have to be seen as something that, far from being a neutral tool that can be used for good or ill, is constitutive of both intra-human and human-nature relations. The recognition of the importance of technology is beginning to appear on the public agenda. Bottom trawling, long accused of damaging habitat and undermining equitable distribution of fisheries resources is being raised as an issue in Newfoundland and Labrador by groups such as the Fisheries Recovery Action Committee and academic researchers such as those involved with Coasts Under Stress.

### 9.4 Moral Ecology versus Managerial Ecology

> The manager represents in his *character* the obliteration of the distinction between manipulative and non-manipulative social relations...The manager treats ends as given, as outside his scope; his concern is with technique, with effectiveness in transforming raw materials into final products, unskilled labour into skilled labour, investment into profits...[a] manager...[in his role] as manager...[is unable] to engage in moral debate...[Managers] restrict themselves to the realms in which rational agreement is possible—that is, of course from their point of view to the realm of fact, the realm of means, the realm of measurable effectiveness (MacIntyre 1981:29).

Since managerial knowledge must be "causal, expressible in generalizations, and must provide...an essentially manipulative ability," it is open to being challenged on both political and ethical grounds (Knight 1998:64). This is different from arguments around the efficacy of manageability discussed in section 9.2. How can relationships with the natural world move beyond instrumental rationality to include communicative rationality and deliberation on the ends as well as the means of all interventions? What is the proper, fitting and virtuous cod fishing practice in Newfoundland and Labrador at this time? These questions constitute a moral rather than a managerial orientation. It is important for open debate to occur about how and why fishing is done—not as a way to learn how maximum sustainable yields can be obtained from fish stocks, but because fishing practices have political and moral consequences for how humans live within ecosystems and how restoration might proceed. This will require coming to democratic agreement on the types of relationships that are wanted and are justified ecologically, politically, economically and ethically at this moment in history. At present, it is difficult to conceptualize discussions over fishing technologies and managerial interventions in moral terms, since technology and management are most often understood in terms of their effectiveness, and effectiveness is not understood to be a moral issue. As MacIntyre observes:

> [We are] unaccustomed to think of effectiveness as a distinctively *moral* concept, to be classed with such concepts as those of rights or of utility. Managers themselves and most writers about management conceive of themselves as morally neutral characters whose skills enable them to devise the most efficient means of achieving whatever end is proposed. Whether a given manager is effective or not is on the dominant view a quite different question from that of the morality of the ends which his effectiveness serves or fails to serve. None the less there are strong grounds for rejecting the claim that effectiveness is a morally neural value. For the whole concept of effectiveness is...inseparable from a mode of human existence in which the contrivance of means is in central part the manipulation of human beings into compliant patterns of behaviour; and it is by appeal to his own effectiveness in this respect that the manager claims authority within the manipulative mode. This effectiveness is a defining and definitive element of a way of life which competes for our allegiance with other alternative contemporary ways of life; and if we are to evaluate the claims of the...managerial mode to a place of authority in *our* lives, an assessment of the...managerial claim to effectiveness will be an essential task" (MacIntyre 1981:71,72).

Explorations of moral versus managerial ecologies in the cod fisheries would focus attention on the relationships that should exist between people and cod and their mutually supporting contexts. What is required here is an emphasis on relational and communicational processes, as well as on the conditions within which Newfoundland and Labradorians access resources. Present competition ought to be replaced by communication, and enclosures of state and private property with an exploration of how to rejuvenate commons and the types of relationships that are associated with them (De Angelis 2005). Leopold (1949), Merchant (1998) and others have proposed alternatives to utilitarian managerial ethics, which are encapsulated in partnership and land ethics where nature is accorded intrinsic values and humans are understood as partners and citizens of land and sea communities. These new forms of ethics remove the emphasis from "finding the most efficient means by which to achieve given ends" (Knight 1998:6) and allow for debates about what ought to constitute "the good." They advocate a mutually respectful relationship between humans and non-humans (Merchant 1998, 2003).

However, these ethics raise difficult questions that will need to be addressed before they can be usefully applied. As mentioned in chapter three, nature cannot speak or be represented factually if political opinion is to be allowed as opposed to managerial rulership. Those who represent nature or other human beings must be seen as putting forth opinions open to contestation and therefore environmental ethics that seek to include nature as a partner and humans as plain member citizens of land and sea communities must continue to address the problem of representation and permit different forms of rationality and argumentation to enter the public sphere.

While instrumental managerial rationality is concerned with "matching means to ends economically and efficiently," practical rationality involves "reasoning about practice, about what should be done in society with others" (Knight 1998: 24,15). When applied to the cod fishery, a focus on practical reason draws attention to how fishing is done and what role it and other extractive ocean activities should play at this point in history. As Knight explains:

> Practical rationality is a property of individuals-in-their-social-relationships rather than of individuals-as-such. To be practically rational I must learn what my good is in different types of situations and I can only achieve that through action with others in which I learn from others and they from me...Such practical learning is a kind of learning that takes place in and through activity, and in and through reflection upon that activity, in the course of both communal and individual deliberation...Practical learning and enquiry are therefore features of various kinds of activity. It is found among farmers and fishing crews, in the work of households and in the practice of crafts (1998:242-243).

The distinction between practical and instrumental learning is another example of how a shift beyond managerial ecology may be discovered within the cod fisheries. An alternative view might ask: "What are the appropriate relationships between cod and people at this point in history?" and seek answers through the application of practical reason with others who are involved directly with fishing. As James Kay observed:

> This does not mean that we abandon rationality. Rather we recognize the limits to rationality. We take the best information we have, establish what it does and does not tell us about the situation, and then lay out our best understanding and uncertainty about the paths open to us. But this is all that rationality can do for us. Generally, our uncertainty is such that rationality alone cannot establish the path to take. Rather it provides us with a set of possibilities. Which we choose is about passion and morality. And in the final analysis, this is what decision making is about. So the concept of rational decision making is non-sequitur (2002:4).

Following Kay (2002) the emphasis would be taken off how many fish are in the ocean to be caught and how the productivity of fish stocks can be improved. Instead, it would remain focussed on how fishing is done, why it is done, and on the ethical and political consequences of different fishing techniques, in light of what we understand the present state of the ocean ecosystem to be in particular places and at particular times. The complexity of the relationally linked ecological and social systems would mean that this conversation could never be closed once and for all. Once the issues of fishing techniques and the ends of fishing are raised, industrial modernity and the tools it has developed in the fishery and other areas of marine exploitation can become a topic for debate rather than a problem domain in which management can deliver effective solutions. Indeed, fishing may need to become oriented to restoration and local food consumption as opposed to extraction for the world market as has been advocated by cod fishers who promote a catch, grow and release form of aquaculture in combination with a limited food fishery (Newfoundland and Labrador All-Party Committee 2003).

These suggestions for a shift from managerial to political and moral ecology are evidently brief sketches. They are meant to indicate some of the new questions that must be asked if we are to break away from managerial ecology.

### 9.5 Conclusion: Where to from here?

> If the old ideas of management don't work, what will? It should be borne in mind that the old ideas are part of a system and world view that dates back at least to Francis Bacon and the beginning of the 17th century. But even if we recognize that certain aspects of this system are dysfunctional, it cannot be replaced quickly or easily (Ludwig 2001:762).

As Kuhn (1962) noted, mere disconfirmation or challenge never displaces a dominant paradigm; only a better alternative does. Operating from a view of science as a normal puzzle-solving exercise, Kuhn took as self-evident that the "better alternative" was one that could accomplish all of the tasks of the former paradigm and add to collective puzzle-solving ability. In post-normal science, the whole notion of what "better" means (in contrast to "more") becomes opened to debate. It no longer becomes self-evident that alternatives have to accomplish everything that the old paradigm achieved since the rules of the game, the ends, become open to critical discussion. This dissertation has not ultimately sought to discover an "answer" or "solution" to the dominance of managerial ecology in the cod fisheries. Indeed, I have argued that a large part of the present difficulty lies in trying to "solve" the cod fisheries "problem" by framing fundamentally political and normative issues as technical problems amenable to managerial solutions. Managerial ecology in the cod fishery is inseparably tied up with industrial modernity itself, and ultimately this whole way of thinking and living will have to be called into question if we are to move beyond the tragic consequences of cod fisheries management.

Why has this task not begun in Newfoundland and Labrador? Why has the cod collapse and biological endangerment not led to a fundament re-organization of the modern managerial relationship between humans and cod? I believe that part of the answer is because such a task is so monumental. It does not readily yield sharp, testable propositions nor does it provide a simple, reductionist prescription that our political and economic systems presently demand. The domination of management all around us has meant that the failure of control and caretaking and the rise of coping has only been able to be experienced as a loss. When coping is experienced in this way, all effort goes into fleeing this position to regain control. I have tried to explore one possible avenue through which alternatives to managerial ecology might be found by highlighting the potential of ontological interpretations of complex ecological science to bring moral and political issues to the fore. When cod, fishers, and the relations between them are understood to be ontologically complex, the pretence of instrumental knowledge cannot be legitimately maintained. When ontological complexity is taken seriously, the challenge of learning how to ecologically and democratically combine the wisdom of common sense (that combines information on "what is") with the imagination of "what ought to be" developed becomes the central issue. The first step toward learning how to live with, rather than manage, the eco-social systems that constitute cod and cod fishers is to accept ontological complexity as their defining feature and understand coping and adapting to nature as an invitation to a new way of being in the world as opposed to a position that must be transcended as soon as possible.

Despite its co-optation, I remain convinced that part of the shift from managerial to other forms of ecology can come about from a thorough recognition of ontological complexity in both biophysical and socio-cultural systems and a realization that the two are linked. The fact that this is a development within ecological science and that fisheries scientists are starting to draw attention to the limits of managerial ecology gives this approach legitimacy and renews the hope that ecology can become a subversive science, destabilizing the foundations of fisheries management instead of acting as its faithful servant. These scientific developments raise normative and political concerns many of which have been identified by fishing peoples themselves from the advent of industrial modernity in the fishery and the birth of cod fisheries management. The evidence from my research suggests that moves beyond managerial ecology in the cod fisheries will require fundamental changes to our understandings of human and non-human nature. At present, however, these changes remain only a dim hope since managerial ecology is not yet widely seen as being part of the problem and there continue to be a multitude of institutions, structures and individuals that rely on the continuation of modern patterns of thought and action.

My research has illustrated that while the idea of managing cod, fishers and the fishery has not gone unopposed, few have been able to think beyond management when proposing alternatives. Future research will have to explore how non-managerial coping can be better articulated and how new research and teaching strategies can be created, so that ecological science, politics and ethics can avoid relocating control and caretaking onto different targets using new means. One avenue of research that needs to be pursued in this regard is the examination of the role of natural and social science in enabling and constraining the representations of nature and culture that permit management-as-control and caretaking to take place. What are the various arguments coming from the sciences that challenge their role as the creators of knowledge for powerful managerial interventions? How can these become organized as challenges to managerial ecology? How can scholars use theories from complexity theory, political ecology and environmental ethics to challenge the undemocratic and anthropocentric elements of managerialism?

Responses to the managed annihilation of wild cod and the culture associated with hunting them in Newfoundland and Labrador provide a choice between two different understandings of coping. One, managerial, involves an interpretation of coping that frames the collapse as an endless series of problems that must be solved in order to regain control and caretaking ability. This has been the dominant path chosen. The other, non-managerial interpretation, frames the cod collapse as a fundamental challenge to the enlightenment goals of controlling and husbanding nature and understands the condition of coping as an invitation to create new goals and new relationships among cod and people.

# BIBLIOGRAPHY

Acheson, J. and McCay, B. 1990. *The Question of the Commons.* University of Arizona Press: Tucson.

Agrawal, A. 2002. Indigenous Knowledge and the Politics of Classification. *International Social Science Journal.* 173:287-297.

Alvesson, M. and Willmott, H. 1992. *Critical Management Studies.* Sage: London.

__________________________. 1996. *Making Sense of Management.* Sage: London.

__________________________. 2002. Identity Regulation as Organizational Control: Producing the appropriate individual. *Journal of Management Studies.* 39(5):619-644.

__________________________. 2003. *Studying Management Critically.* Sage: London.

Anderies, J. 2002. The Transition from Local to Global Dynamics: A proposed framework for agent-based thinking in socio-ecological systems. IN. *Complexity and Ecosystem Management: The theory and practice of multi-agent systems.* ED. Janssen, M. Edward Elgar: Northhampton, MA.

Anderson, J. (DFO) 2004. Interview on Fisheries Broadcast on Crab Stock Assessment and Quotas for 2004. *Fisheries Broadcast.* April 7. CBC Radio. St. John's, NL.

Apostle, R.; Barrett, G.; Holm, P.; Jentoft, S.; Mazany, L.; McCay, B. and Mikalsen, K. 1998. *Community, State, and Market on the North Atlantic Rim: Challenges to Modernity in the Fisheries.* University of Toronto Press: Toronto.

AquaNet. 2004. *AquaNet: Canada's Research Network on Aquaculture.* Accessed on January 10, 2004 at: http://www.aquanet.ca/English/mandate/index.php.

Arnason, R.; Hannesson, R. and Schrank, W. 2000. Costs of Fisheries Management: The cases of Iceland, Norway and Newfoundland. *Marine Policy.* 24: 233-24.

Armstrong, P. 1995. The Feminization of the Labour Force: Harmonizing Down in a Global Economy. IN. *Invisible: Issues in Women's Occupational Health.* EDS. K. Messing, B. Neis, and L. Dumais. Gynergy Books: Charlottetown.

Arnstein, S. 1969. A ladder of citizen participation in the USA. *Journal of American Institute of Planners.* 35:216-224.

Bailey, S. 2004. *Workers 'Fleeced' As EI Surplus Grows.* Canadian Press. Accessed online on March 25, 2004 at: http://cnews.canoe.ca/CNEWS/Canada/2004/02/18/pf-352381.html.

Bailey, C.; Jentoft, S. and Sinclair, P. 1996. *Aquaculture Development: Social dimensions of an emerging industry*. Westview Press: Oxford.

Baker, M.; Dickinson, A.B. and Sanger, C.W. 1992. Adolph Nielsen: Norwegian Influence on Newfoundland Fisheries in the Late 19th- Early 20th Century. *Newfoundland Quarterly*. 87(2):25-35.

Banerjee, S.B. and Linstead, S. 2004. Masking subversion: Neocolonial embeddedness in anthropological accounts of indigenous management. *Human Relations*. 57(2): 221–247.

Barange, M. 2003. Ecosystem science and the sustainable management of marine resources: From Rio to Johannesburg. *Frontiers in Ecology and the Environment.* 1(4):190-196.

Barange, M.; Werner, F.; Perry, I. and Fogarty, M. 2003. The Tangled Web: Global fishing, global climate, and fish stock fluctuations. *Global Change Newsletter*. 56(December):24-27.

Bauman, Z. 1991. *Modernity and Ambivalence.* Polity Press: Cambridge.

_________. 2001. *The Individualized Society.* Cambridge: Polity press.

Bavington, D. 2000. *From Hunting to Farming: Exploring the Development of Industrial Aquaculture in Newfoundland and Labrador from a Complex Systems Perspective.* Awarded the Canadian Policy Graduate Research Award. Federal Policy Research Initiative. Ottawa: Ontario. (Unpublished). Accessible online at: http://www.jameskay.ca/about/grad/aquac.pdf.

___________. 2001. From Jigging to Farming. *Alternatives*. 27(4):16-21.

___________. 2002. Managerial Ecology and It's Discontents: Exploring the Complexities of Control, Careful Use and Coping in Resource and Environmental Management. *Environments*. 30(3):3-21.

___________. 2003a (October). Gilbert's Bay Proposed Marine Protected Area: Socio-Ecological Considerations. Presentation to the *Newfoundland and Labrador Natural History Society and the Canadian Parks and Wilderness Society (CPAWS) - Newfoundland & Labrador.* Marine Institute, St. John's, NL.

___________. 2003b (May). Cod Aquaculture as a Restoration Tool for an Endangered Species. *Canadian House of Commons Standing Committee on Fisheries and Oceans.* St. John's, NL.

Bavington, D. and Kay, J. 2003. *Fisheries Systems in an Age of Globalization: Ecosystem-Based Insights on Monitoring, Management and Governance Challenges.*

American Fisheries Society 133rd Annual Meeting. August 10-14. Québec City, Québec, Canada.

____________________. 2005. Ecosystem-Based Insights on Northwest Atlantic Fisheries in an Age of Globalization. IN. *Globalization: Effects on Fisheries Resources.* EDS. M. Schechter, W. Taylor and L. Wolfson. Cambridge University Press: Cambridge, UK.

Bavington, D; Grzetic, B.; and Neis, B. 2004. The Feminist Political Ecology of Fishing Down: Reflections from Newfoundland and Labrador. *Studies in Political Economy.* 73:159-182.

Bella, D. 1997. Organizational Systems and the Burden of Proof. IN. *Pacific Salmon and Their Ecosystems.* EDS. D. Stouder, P. Bisson and R. Naimon. Chapman & Hall: New York.

Ben-Yami, M. 2004. *The Faeroese Lecture.* Accessed online on May 4, 2005 at: http://sharpgary.org/FaeroesLecture.html

Berkes, F. 2003. Alternatives to Conventional Management: Lessons from Small-Scale Fisheries. *Environments.* 31(1):5-19.

Berkes, F. and Folke, C. 1998. *Linking Social and Ecological Systems: Management practices and social mechanisms for building resilience.* Cambridge University Press: New York.

Berkes, F.; Mahon, R.; McConney, P.; Pollnac, R. and Pomeroy, R. 2001. *Managing Small-Scale Fisheries: Alternative directions and methods.* IDRC: Ottawa.

Bertlanffy, L. 1950. An Outline of General Systems Theory. *British Journal of Philosophy of Science.* 1:134-65.

Beverton, R.J.H. and Holt, S.J. 1957. *On the Dynamics of Exploited Fish Populations.* Chapman and Hall: London.

Blades, T. 1996. Three Years in the Woodshed. *Sunday Morning.* December 1. CBC Radio: Toronto.

Blake, R. 2000. *From Fisherman to Fish: The Evolution of Canadian Fishery Policy.* Irwin Publishing: Toronto.

Blumenthal, D. and Jannink, J. 2000. A Classification of Collaborative Management Methods. *Conservation Ecology.* 4(2):13.

Bocking, S. 2004. *Nature's Experts: Science, Politics, and the Environment.* Rutgers University Press: New Brunswick, NJ

Bookchin, M. 1994. *The Philosophy of Social Ecology: Essays on Dialectical Naturalism.* Black Rose Books: Montreal.

Botkin, D. 1990. *Discordant Harmonies: A new ecology for the 21st century.* Oxford University Press: New York.

Bourdieu, P. 1998. The Essence of Neoliberalism. *Le Monde Diplomatique.* Translated by J.J. Shapiro. December, 1998.

Bourke, S and Meppem, T. 2000. Privileged Narratives and Fictions of Consent in Environmental Discourse. *Local Environment.* 5(1):299-310.

Boyce, D. 2002. Cod *Aquaculture—"Egg to Plate Project 2001".* Aquaculture Research Development Facility. Ocean Science Centre. Logy Bay, NL.

_______. 2003. *Cod Aquaculture Research Development Facility Tour.* March 9. Ocean Science Centre. Logy Bay, NL.

Boyle, M.; Kay. J. and Pond, B. 2001. Monitoring in Support of Policy: an Adaptive Ecosystem Approach. IN. *Encyclopaedia of Global Environmental Change (Volume 4).* ED. T. Munn. John Wiley & Son: London.

Braverman, H. 1974. *Labor and Monopoly Capital.* Monthly Review Press: New York.

Brown, W. 2003. Neo-liberalism and the End of Liberal Democracy. *Theory & Event* 7(1): 1-21.

Bryant, R. and Wilson, G. 1998. Rethinking Environmental Management. *Progress in Human Geography.* 22(3): 321-343.

Bundy, A. 1998. The Red Light and Adaptive Management. IN. *Reinventing Fisheries Management.* EDS. T. Pitcher, P. Hart and D. Pauly. Kluwer Academic Publishers: London.

Burke, L. and Brander, G.L. 2000. Canadian Experience with Individual Transferable Quotas. IN. *Use of Property Rights in Fisheries Management.* ED. R. Shotton. FAO: Rome. Accessed online on September 24, 2004 at: http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/003/X7579E/x7579e00.htm.

Busch, W.; Brown, B.; and Mayer, G. (eds). 2003. *Strategic Guidance for Implementing an Ecosystem-based Approach to Fisheries Management.* United States Department of Commerce. National Oceanic and Atmospheric Administration. NMSF: Silver Springs, MD.

Caddy, J. 1999. Fisheries Management in the Twenty-First Century: Will new paradigms apply? *Reviews in Fish Biology and Fisheries.* 9:1-43.

Caddy, J. and Cochrane, K. 2001. A Review of Fisheries Management Past Present and Some Future Perspectives for the Third Millennium. *Oceans and Coastal Management.* 44:653-682.

Caddy, J. and Regier, H. 2002. Policies for Sustainable and Responsible Fisheries. IN. *The Encyclopedia of Global Environmental Change (Volume 4).* ED. Mostafa K. Tolba. John Wiley & Sons: Mississauga.

Caddy, J. F. & Garibaldi, L. 2000. Apparent changes in the trophic composition of world marine harvests: the perspective from the FAO capture database. *Ocean & Coastal Management.* 43:615–655.

Cadigan, S. 1995. *Hope and Deception in Conception Bay: Merchant-settler relations in Newfoundland, 1785-1855.* University Of Toronto Press: Toronto.

________. 1999a. The Moral Economy of the Commons: Ecology and Equity in the Newfoundland Cod Fishery, 1815-1855. *Labour/Le Travail.* 43(Spring):9-42.

________. 1999b. Failed Proposals for Fisheries Management and Conservation in Newfoundland, 1855-1880. In. *Fishing Places, Fishing People.* Eds. D. Newell and R. Ommer. University of Toronto Press: Toronto.

________. 2001. Whose Fish? Science, ecosystems and ethics in fisheries management literature since 1992. *Acadiensis.* 29(1):171-195.

________. 2003. The Moral Economy of Retrenchment and Regeneration in the History of Rural Newfoundland. In. *Retrenchment and Regeneration in Rural Newfoundland.* Ed. R. Byron. University of Toronto Press: Toronto.

Cadigan, S. and Hutchings, J. 2001. Nineteenth-Century Expansion of the Newfoundland Fishery for Atlantic Cod: An Exploration of Underlying Causes. In. *The Exploited Seas: New Directions for Marine Environmental History.* Eds. P. Holm, T. Smith and D. Starkey. Research in Maritime History No.21. International Maritime Economic History Association, Maritime Studies Research Unit, Memorial University: St. John's, NL.

Caines, J. (Seawater Manager, Newfoundland Cod Farms). 2003. Update on Hatchery Produced Juvenile Cod Growout. Presentation at *Cultivating a Sustainable Future—Cold Harvest™ 2003.* Newfoundland Aquaculture Industry Association Annual Conference. March 19. Gander, NL.

Canada. 2004. *Fisheries Act.* R.S., c. F-14, s. 1. Accessed online on October 28, 2004 at: http://laws.justice.gc.ca/ en/ F-14/ 60370.html.

Canadian Broadcasting Corporation (CBC). October 4, 2004a. *Crab Science in Jeopardy, Fishermen Fear*. STJOHNS.CBC.CA. Accessed on October 4, 2004 at: http://stjohns.cbc.ca/ regional/servlet/View?filename= nf_crab_science_20041004.

___________________________________. October 4, 2004b. *Salmon Farms on Verge of Collapse*. STJOHNS.CBC.CA. Accessed on January 10, 2005 at: http://stjohns.cbc.ca/ regional/servlet/View? filename=nf_salmon_Dobbin_20041004.

___________________________________. November 3, 2004c. *Loan Program to Aid Struggling Fish Farms*. STJOHNS.CBC.CA. Accessed on January 25, 2005 at: http://stjohns. cbc.ca/regional/servlet/View?filename=nf_aquaculture_20041103.

Capra, F. 1996. *The Web of Life: A new scientific understanding of living systems*. Doubleday: Toronto.

_______. 2002. *The Hidden Connections: Integrating the biological, cognitive, and social dimensions of life into a science of sustainability*. Doubleday Press: New York.

Carr, E. 1998 (May 23). Survey: The Deep Green Sea—A Second Fall. *The Economist*. 347(8069):S3.

Cashin, R. 1993. *Charting a New Course: Towards the Fishery of the Future*. Report of the Task Force on Incomes and Adjustment in the Atlantic Fishery. Minister of Supply and Services Canada: Ottawa.

Castree, N. 2003. Commodifying What Nature? *Progress in Human Geography*. 27(3):273-297

Chan, K.; Stenseth, N.; Kittilsen, M.; Gjosaeter, J.; Lekve, K.; Smith, T.; Tveite, S. and Danielssen, D. 2003. Assessing the Effectiveness of Releasing Cod Larvae for Stock Improvement with Monitoring Data. *Ecological Applications*. 13(1):3-22.

Charles, T. 2001. *Sustainable Fishery Systems*. Blackwell Science: Oxford.

Checkland, P. and Scholes, J. 1990. *Soft Systems Method in Action*. John Wiley: New York.

Cilliers, P. 1998. *Complexity and Postmodernism: Understanding complex systems*. Routledge: New York.

Clarke, J. 2001. "Globalization and Welfare States: Some Unsettling Thoughts." IN. *Globalization and European Welfare States: Challenges and Change*. EDS. R. Sykes, B. Palier and P. Prior. Palgrave: Basingstoke.

Clegg, S. and Palmer, G. 1996. Introduction: Producing Management Knowledge. IN. *The Politics of Management Knowledge*. EDS. S. Clegg and G. Palmer. Sage Publishing: London.

Colbourne, E.B. 2004. Decadal Changes in the Ocean Climate in Newfoundland and Labrador Waters from the 1950s to the 1990s. *Journal of Northwest Atlantic Fisheries Science*. 34:41-59. Accessed online on April 15, 2004 at: http://www.nafo.int/ publications/frames/ PuFrJour34.html.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2003. *COSEWIC Status Assessments, May 2003*. Accessed on May 4, 2003 at: http://www.cosewic.gc.ca/ htmlDocuments/Detailed_Species_Assessment_e.htm.

________________________________________. 2004. *COSEWIC Public Consultations on Atlantic Cod Endangered Designation*. Airport Plaza. October 28. St. John's, NL.

Conley, D. 1998. Environmental Concerns: The Anti-Salmon Farming Lobby in BC. *Aquaculture Magazine*. July/August:36-51.

Cooke, B. 2004. The Managing of the (Third) World. *Organization*. 11(5):603-629.

Cooke, B. and Kothari, U. 2002. The Case for Participation as Tyranny. IN. *Participation: The New Tyranny?* EDS. B. Cooke and U. Kothari. Zed Books: London.

Cortner, H. and Moote, M. 1999. *The Politics of Ecosystem Management*. Island Press: Washington, D.C.

Coward, H.; Rosemary, O. and Pitcher, T. (Eds). 2000. *Just Fish: Ethics and Canadian Marine Fisheries*. ISER Books: St. John's, NL.

Crainer, S. 2000. *The Management Century*. Jossey-Bass Publishers: San Francisco.

Crosby, A. 1993. *Ecological Imperialism: The biological expansion of Europe 900-1900*. Cambridge University Press: New York.

Crowley, B. (Ed). 1996. *Taking Ownership: Property Rights and Fisheries Management on the Atlantic Coast*. Atlantic Institute for Market Studies: Halifax.

Curtis, D. 2002. Sculpin Project Update. Presentation to the *2002 Fisheries Forum: Fisheries Issues and Opportunities*. Fish Harvesters' Resource Centres. November 14. Renews, NL.

Darier, E. (Ed). 1999. *Discourses of the Environment*. Blackwell: Oxford.

Davenport, J.; Black, K.; Burnell, G.; Cross, T.F.; Culloty, S.; Ekaratne, S.U.K.; Furness, R.; Mulcahy, M. and Thetmeyer, H. 2003. *Aquaculture: The Ecological Issues.* Blackwell: London.

Davis, R. Forthcoming. All or Nothing: VLT Gambling as Resistance to Economic Restructuring in Newfoundland. *Identities: Global Studies in Culture and Power.*

Dean, K. 2003. *Capitalism and Citizenship: The Impossible Partnership.* Routledge: New York.

Dean, M. and Hindness, B. 1998. *Governing Australia: Studies in Contemporary Rationalities of Government.* Cambridge University Press: Cambridge.

Dean-Simmons, B. 2002. Cod Closure Threatens Fledgling Fishery. *The Express.* November 27-December 3, pg. 7.

De Angelis, M. 2005. PR like Process! Strategy from the Bottom-Up. *Ephemera.* 5(2):193-204

_______________. 2004b. Independent View Critical: FRCC a necessary component for Fisheries Minister to judge groundfish stocks. *The Express.* March 10-16. pp.24.

Department of Fisheries and Aquaculture (DFA). 2002. *Government of Newfoundland and Labrador Aquaculture Licensing Guide.* Licensing and Inspection Division, Aquaculture Branch. DFA. Grand-Falls: NL.

Department of Fisheries and Oceans Canada (DFO). 1995a. *Sentinel Fishery Projects.* Accessed on October 10, 2004 at: http://www.dfo-mpo.gc.ca/media/backgrou/1995/hq-ac34_e.htm.

__________________________________________.1995b. *Federal Aquaculture Development Strategy.* Government of Canada: Ottawa.

__________________________________________.1996. *The Oceans Act of Canada.* Bill C-26. Government of Canada: Ottawa.

__________________________________________. 2001a. *A Canadian Perspective on the Precautionary Approach/Principle Discussion Document.* Accessed online on January 20, 2004 at: http://www.dfo-mpo.gc.ca/cppa/HTML/discussion_e.htm.

__________________________________________. 2001b. *The Management of Fisheries on Canada's Atlantic Coast: A discussion document on policy direction and principles.* Atlantic Fisheries Policy Review: Ottawa.

__________________________________________. 2002a. *Proceedings on the DFO Workshop on Implementing the Precautionary Approach in Assessments and Advice.* Canadian Science Advisory Secretariat. Accessed online on January 20, 2004 at http://www.dfo-mpo.gc.ca/csas/ Csas/Proceedings/2002/ PRO2002_009b.pdf.

________________________________________. 2002b. *Canada's Ocean Strategy: Policy and operational framework for integrated management of estuarine, coastal and marine environments in Canada*. Fisheries and Oceans Canada: Ottawa.

________________________________________. 2003a. *Northern (2J+3KL) Cod Stock Status Report A2-01*. DFO-NL Region: St. John's, NL.

________________________________________. 2004a. *Statistical Services.* Accessed on March 12, 2004 at: http://www.dfo-mpo.gc.ca/communic/ statistics/ main_e.htm.

________________________________________. 2004b. A Recent Account of Canada's Atlantic Cod Fishery. Accessed on August 25, 2004 at: www.dfo-mpo. gc.ca/kids-enfants /map-carte/map_e.htm.

________________________________________. 2004c. Anti-Poaching Advertising. IN. *Crime Stoppers Newfoundland and Labrador 2nd Annual Awareness Guide*. Crime Stoppers: St. John's, NL.

Drinkwater, K.F. 2002. A Review of the Role of Climate Variability in the Decline of Northern Cod. *American Fisheries Society Symposium—Fisheries in a Changing Climate*. 32:113-130.

Du Gay, P. 1996. Making Up Managers: Enterprise and the ethos of bureaucracy. IN. *The Politics of Management Knowledge*. EDS. S. Clegg and G. Palmer. Sage: London.

Duden, B. 1993. Population. IN. *The Development Dictionary*. ED. W. Sachs. Zed Books: London.

Durrenberger, E. P. and King, T. 2000. Introduction. IN. *State and Community in Fisheries Management: Power, Policy, and Practice*. EDS. E. P. Durrenberger and T. King. Bergin and Garvey: London.

Ecology Action Centre. 2004. *Lawsuit Challenging Unregulated Dragging on George's Bank.* Accessed on March 31, 2004 at: http://www.ecologyaction.ca/marine_issues/ courtcase.htm.

Ehrenfeld, D. 1978. *The Arrogance of Humanism*. Oxford University Press: New York.

___________. 1991. The management of diversity: A conservation paradox. IN. *Ecology, Economics, Ethics: The broken circle*. EDS. Herbert, Bormann, and Kellert. Yale University Press: London.

__________. 1993. *Beginning Again: People and nature in the new millennium*. Oxford University Press: New York.

Enzle, M.E. and Anderson, S.C. 1993. Surveillant intentions and intrinsic motivation. *Journal of Personality and Social Psychology*. 64:257-266

Ernande B.; Dieckmann U. and Heino M. 2002. *Fisheries-Induced Changes in Age and Size at Maturation and Understanding the Potential for Selection-Induced Stock Collapse*. International Council for the Exploration of the Sea. CM 2002/Y:06. Accessed online on March 2, 2004 at: http://www.ices.dk/products/CMdocs/2002/CM2002.pdf
Escobar, A. 1995. *Encountering Development: The Making and Unmaking of the Third World*. Princeton University Press: Princeton.

Esteva, G., Stuchul, D. and Prakash, M. 2005. From a Pedagogy for Liberation to Liberation from Pedagogy. IN. *Rethinking Friere: Globalization and the Environmental Crisis*. EDS. C. Bowers and F. Apffel-Marglin. Lawrence Erlbaum Associates, Publishers: New Jersey.

Evernden N. 1985. *The Natural Alien*. University of Toronto Press: Toronto.

_________. 1993. *The Social Construction of Nature*. Johns Hopkins University Press: Baltimore.

Fairlie, S.; Hildyard, N.; Lohmann, L. and Sexton, S. 1993. *Whose Common Future? Reclaiming the Commons*. Earthscan: London.

Fall, J. 2002. Divide and Rule: Constructing human boundaries in 'boundless nature'. *GeoJournal*. 58:243-251.

Felt, L.; Neis, B. and McCay, B. 1997. Co-management. IN. *Northwest Atlantic Groundfish: Perspectives on a Fishery Collapse*. EDS. J. Boreman, B.S. Nakashima, J. Wilson and RL. Kendall. American Fisheries Society: Bethesda.

Fennelly, S. 2003a. Newfoundland Cod Comeback! *Fish Farming International*. 30(12):1

_________. 2003b. Newfoundland's First Cod Hatchery. *Fish Farming International*. 30(12):34-36.

Ferguson, J. and A. Gupta. 2002. Spatializing States: Toward an Ethnography of Neoliberal Governmentality. *American Ethnologist*. 29(4): 981-1002.

Finlayson, A.C. and McCay, B. 1998. Crossing the Threshold of Ecosystem Resilience: The commercial extinction of northern cod. IN. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. EDS. F. Berkes and C. Folke. Cambridge University Press: Cambridge, UK.

Fielding, M. 2001. Learning Organisation or Learning Community? A Critique of Senge. *Reason in Practice*. 1(2):17-2.

Finlayson, A. 1994. *Fishing for Truth: A Sociological Analysis of Northern Cod Stock Assessments from 1977-1990.* ISER Books: St. John's, NL.

Fischer, F. 2000. *Citizens, Experts and the Environment: The politics of local knowledge.* Duke University Press: Durham, NC.

Fisheries Broadcast. 2003. *Fishline Call-in Show.* Canadian Broadcasting Corporation Radio Program. October 16. St. John's, NL.

Fisheries Food and Allied Workers Union (FFAW). 2004. Preserving the Independence of the Inshore Fleet in Canada's Atlantic Fisheries. Presentation to the *DFO Consultation on the Atlantic Fisheries Policy Review.* January 20th. Fairmont Hotel. St. John's, NL.

Fisheries Resource Conservation Council (FRCC). 1997. Towards and Ecosystem Approach to Fisheries Management. *Report of the FRCC's Environment and Ecology Workshop.* University of Moncton. December 15-16. Government of Canada: Ottawa. FRCC.98.R.3.

________________________________________. 2002a. *Public Consultation on Northern Cod Stock Status in 3Ps.* December 8. Sunnyside, Newfoundland.

________________________________________. 2002b. *2002/2003 Conservation Requirements for 2J3KL Cod Stocks.* Minister of Public Works and Government Services Canada: Ottawa.

________________________________________. 2003a. *Public Consultation on Northern Cod Stock Status in 2J3KL.* March 4. Airport Plaza. St. John's, Newfoundland.

________________________________________. 2003b. *2003/2004 Conservation Requirements for 2J3KL Cod Stocks.* Minister of Public Works and Government Services Canada: Ottawa.

________________________________________. 2004a. *What is the FRCC?* Accessed online on November 4, 2004 at: http://www.frcc.ca/mandate.htm.

________________________________________. 2004b. *2004/2005 Conservation Requirements for 3Ps Cod.* Minister of Public Works and Government Services Canada: Ottawa.

Fischer, F. 2000. *Citizens, Experts, and the Environment: The politics of local knowledge.* Duke University Press: Durham.

Flood, R. 1999. *Rethinking the Fifth Discipline: Learning within the unknowable.* Routledge: New York.

Folke, C. and Kautsky, N. 1992. Aquaculture with its Environment: Prospects for Sustainability. *Ocean & Coastal Management.* 17:5-24.

Folke, C.; Kautsky, N.; Berg, H.; Jansson, A. and Troell, M. 1998. The Ecological Footprint Concept for Sustainable Seafood Production: A Review. *Ecological Applications.* 8(1):S63-S71.

Folke, C.; Berkes, F. and Colding, J. 2000. Ecological Practices and Social Mechanisms for Building Resilience and Sustainability. IN. *Linking Social and Ecological Systems: Management practices and social mechanisms for building resilience.* EDS. F. Berkes and C. Folke. Cambridge University Press: New York.

Food and Agriculture Organization (FAO), United Nations. 1995. *Precautionary Approach to Fisheries. Part 1: Guidelines on the precautionary approach to capture fisheries and species introductions.* FAO/Swedish Board of Fisheries, Fisheries Technical Paper 350: Part 1:47.

________________________________________. 2002. *The State of the World Fisheries and Aquaculture.* Food and Agriculture Organization of the United Nations: Rome.

________________________________________. 2003a. The ecosystem approach to marine capture fisheries. *FAO Technical Guidelines for Responsible Fisheries.* No.4(Suppl.2).

________________________________________. 2003b. *Report of the expert consultation on ecosystem-based fisheries management.*: Reykjavik, Iceland, 16-19 September 2002. FAO fisheries report. No. 690. Food and Agriculture Organization of the United Nations: Rome.

________________________________________. 2004. *The State of World Fisheries and Aquaculture (SOFIA) 2004.* FAO Fisheries Department: Rome.

Foster, J.B. 2000. *Marx's Ecology: Materialism and Nature.* New York University Press: New York.

Francis, G. 2004. Personal Email Communication. February 9th.

Franklin, U. 1990. *The Real World of Technology.* CBC Massey Lectures. Canadian Broadcasting Corporation: Toronto.

Funtowicz, S. and Ravetz, J. 1993. Science for the Post-Normal Age. *Futures.* (September):739-755.

Garcia, S.M. 1994. The Precautionary Principle: Its implications in capture fisheries management. *Ocean & Coastal Management.* 22:99–125.

Garcia, S.M.; Zerbi, A.; Aliaume, C.; Do Chi, T. and Lasserre, G. 2003. The Ecosystem Approach to Fisheries: Issues, terminology, principles, institutional foundations, implementation and outlook. *FAO Fisheries Technical Paper*. No. 443. FAO: Rome.

Garlauskas, A. B. 1975. Conceptual Framework of Environmental Management. *Journal of Environmental Management.* 3(3):185-203.

Ghoshal, S. 2005. Bad Management Theories are Destroying Good Management Practices. *Academy of Management Learning and Education*. 4(1):75-91.

Giddens, A. 1991. *Modernity and Self-Identity: Self and Society in the Late Modern Age.* Stanford University Press: Stanford.

Glacken, C. J. 1973. *Traces on the Rhodian shore; nature and culture in Western thought from ancient times to the end of the eighteenth century.* University of California Press: Berkeley.

Gordon, H.S. 1953. An Economic Approach to the Optimum Utilization of Fishery Resources. *Journal of the Fisheries Research Board of Canada*. 10:442-57.

Government of Canada. 1998. *Privatization and Quota Licensing in Canada's Fisheries.* Report of the Standing Senate Committee on Fisheries. First session: Thirty-Sixth Parliament. Accessed on-line on September 10th, 2004 at: http://www.parl.gc.ca/36/1/ /commbus/senate/com-e/fish-e/rep-e/rep03dec98-e.htm.

____________________. 2004. Providing Employment Income Security. Accessed online on March 30, 2004 at: http://canadianeconomy.gc.ca/english/economy/ 1941ui.html.

Government of Newfoundland. 1849. Journal of the House of Assembly of Newfoundland 1848-1849. St. John's, NL.

Government of Newfoundland and Labrador. 1990. Newfoundland and Labrador Aquaculture Act: An Act Respecting the Encouragement and Regulation of an Aquaculture Industry in the Province. Accessed online on January 10, 2004 at: http://www.gov.nf.ca/hoa/statutes/a13.htm#5.

__________________________________. 1998. *Sharing Coastal Resources: A study of conflict management in the Newfoundland and Labrador Aquaculture Industry.* Prepared for Aquaculture component of the economic renewal agreement (ACERA). Accessed on February 20, 2000 at: http://www.gove.nf.ca/ fishaq/ACERA/ACERA.htm

Grafton, R.Q. 1993. *Individual Transferable Quotas and the Groundfish Fisheries of Atlantic Canada*. Department of Fisheries and Oceans: Ottawa.

Grant, S.M. 2004. *The Mortality of Snow Crab Discarded From Newfoundland and Labrador's Trap Fishery: At Sea Experiments on the Effect of Drop Height and Air Exposure Duration.* Presentation to the Canadian Conference on Fisheries Research (CCFFR) and the Society of Canadian Limnologists (SCL) Annual Meeting. January 8-10. St. John's, NL.

Gray, J. 2000. Who Needs Cod Anyway? *Globe and Mail Newspaper.* Saturday March 11. A18.

Gray, T. 2002. Fisheries Science and Fishers' Knowledge. Presentation to *ENSUS 2002 - Marine Science and Technology for Environmental Sustainability Conference.* University of Newcastle Upon Tyne, UK. Accessed on September 24, 2003 at: http://www.efep.org/ TSGENSUS.pdf.

Grey, C. 1996. Towards a Critique of Managerialism: The contribution of Simone Weil. *Journal of Management Studies.* 33(5): 591-611.

______. 1999. We Are All Managers Now; We Always Were: On the development and demise of management. *Journal of Management Studies.* 36(5): 561-585.

Grotius, H. 1633 (2000). *The Freedom of the Seas or the Right Which Belongs to the Dutch to Take Part in the East Indian Trade.* Batoche Books: Kitchener. Accessed online on June 2, 2004 at: http://socserv2.mcmaster.ca/~econ/ugcm/3ll3/grotius/ Seas.pdf

Grumbine, E. 1997. Reflections on "What is Ecosystem Management". *Conservation Biology.* 11(1): 41-47.

Grzetic, B. 2004. *Women Fishes These Days.* Fernwood: Halifax.

Grzybowski, A and Slocombe, S. 1988. Self-Organization Theories and Environmental Management: The case of South Moresby, Canada. *Environmental Management.* 12:463-478.

Hacking, I. 1990. *The Taming of Chance.* Cambridge University Press: New York.

________. 1999. The *Social Construction of What?* Harvard University Press: Cambridge, Mass.

Haila, Y. 1998. Political Undercurrents of Modern Ecology. *Science as Culture* 7(4): 465-491.

Halliday, R.G. and A.T. Pinhorn. 1990. The Delimination of Fishing Areas in the Northwest Atlantic. *Journal of Northwest Atlantic Fisheries Sciences.* 10:1-51.

Hammond, D. 1997. Ecology and Ideology in the General Systems Community. *Environment and History.* 3:197-207.

Hannsen, L.; Jacobsen, J. and Lund, R. 1999. The Incidence of Escaped Farmed Atlantic Salmon, *Salmo salar* L., in the Faroese Fishery and Estimates of Catches of Wild Salmon. *Journal of Maritime Science.* 56:200-206.

Hansen, H.K. and D. Salskov-Iversen. 2002. Managerialised Patterns of Political Authority: Partners, Peddlers and Entrepreneurial People. *Critical Quarterly.* 44(3):4-18.

Hardin, G. 1968. The Tragedy of the Commons. *Science.* 162:1243-48.

Harrington, M. 1987. New Light on Dildo Fish Hatchery. *The Evening Telegram.* November 16. p.6.

Harris, L. 1990. *Independent Review of the State of the Northern Cod Stock.* Prepared for the Department of Fisheries and Oceans. May 15.

Harris, M. 1998. *Lament for an Ocean: The Collapse of the Atlantic Cod Fishery, A True Crime Story.* McClelland and Stewart: Toronto.

Harte, R. 2002. Emerging Fisheries Development (Jelly Fish). Presentation to the *2002 Fisheries Forum: Fisheries Issues and Opportunities.* Fish Harvesters' Resource Centres. November 14. Renews, NL.

Harvey, D. 1993. The nature of environment: The dialectics of social and environmental change. *The Socialist Register*: New York.

Hayles, K. (ed). 1991. Introduction: Complex Dynamics in Literature and Science. In. *Chaos and Order.* Ed. Hayles, K. The University of Chicago Press: Chicago

________. 1999. *How We Became Post Human.* University of Chicago Press: Chicago.

Head, C.G. 1976. *Eighteenth Century Newfoundland.* McClelland & Stewart: Toronto.

Heidegger, M. 1977. *The Question Concerning Technology.* Harper and Row: New York.

Hengeveld, R. and Walter, G.H. 1999. The Two Coexisting Ecological Paradigms. *Acta Biotheoretica.* 47:141-170.

__________________________. 2000. The Structure of the Two Ecological Paradigms. *Acta Biotheoretica.* 48(1):15-46.

High, S. 2001. Working for Uncle Sam in Wartime Newfoundland and Labrador: A Labour History of the "Friendly Invasion". Presentation to *Imaging a Region: Constructing and De-Constructing Atlantic Canada.* August 25. St. Francis Xavier University, Antigonish, N.S.

Higgins, V. 2001. Calculating Climate, Advanced Liberalism and the Governing of Risk in Australian Drought Policy. *Journal of Sociology*. 37:299-316.

Holling, C.S. 1976. Resilience and Stability of Ecosystems. IN. *Evolution and Consciousness: Human systems in transition*. EDS. E. Jantsch and C.H. Waddington. Addison Wesley: Reading, Mass.

___________. 1995. What Barriers, What Bridges? IN. *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. EDS. L. H. Gunderson, C. S. Holling and S. S. Light. Columbia University Press: New York.

Holling, C.S. and Meffe, G. 1996. Command and Control and the Pathology of Natural Resource Management. *Conservation Biology*. 10(2):328-337.

Holling, C. S., Berkes, F. and Folke, C. 2000. Science, Sustainability and Resource Management. *Linking Social and Ecological Systems*. F. Berkes and C. Folke. Cambridge University Press: Cambridge

Holm, P. 1996. Fisheries Management and the Domestication of Nature. *Sociologia Ruralis*. 36(2):177-188.

_______. 2001. *The Invisible Revolution: The Construction of Institutional Change in the Fisheries*. Unpublished Doctoral Dissertation. Norwegian College of Fisheries Science, University of Tromso, Tromso, Norway.

_______. 2003. Crossing the Border: On the Relationship Between Science and Fishermen's Knowledge in a Resource Management Context. *Maritime Studies (MAST)*. 2(1):1-22

Hoopes, J. 2003. *False Prophets: The gurus who created modern management and why their ideas are bad for business today*. Perseus Publishing: Cambridge, MA.

Hueglin, T. 1999. *Early Modern Concepts for a Late Modern World: Althusius on Community and Federalism*. Wilfrid Laurier Press: Waterloo.

Hutchings, J. and Myers, R.A. 1995. The Biological Collapse of Atlantic Cod off Newfoundland and Labrador: An exploration of historical changes in exploitation, harvesting technology, and management. IN. *The North Atlantic Fisheries: Successes, Failures, and Challenges*. EDS. R. Arnason and L. Felt. The Institute of Island Studies: Charlottetown, P.E.I.

Hutchings, J., Neis, B. and Ripley, P. 2002. The "Nature" of Cod, *Gadus morhua*. IN. *The Resilient Outport: Ecology, economy, and society in rural Newfoundland*. ED. R. Ommer. ISER Press: St. John's.

Hutchings, J. 2004. *Life History Consequences of Over-Exploitation to Population Recovery of Northwest Atlantic Cod.* Presentation to the Canadian Conference on Fisheries Research (CCFFR) and the Society of Canadian Limnologists (SCL). January 9. St. John's, NL.

Huxley, T.H. 1883. *Inaugural Address to the Fisheries Exhibition.* London, UK. Accessed on September 15, 2003 at: http://aleph0.clarku.edu/huxley/SM5/fish.html

International Council for the Exploration of the Sea (ICES). 2003a. *Workshop on Synthesis of the Cod and Climate Program.* New Bedford, USA. May 5-7, 2003. CM2003/c:10.Ref.D,G. Denmark: Copenhagen.

_______________________________________. 2003b. *ICES/GLOBEC Working Group in Cod and Climate Change.* New Bedford, USA. May 7-9, 2003. CM2003/c:10. Ref.D,G. Denmark: Copenhagen.

Illich, I. 1973. *Tools for Conviviality.* Harper and Row: New York.

______. 1983. Silence is a Commons. *Co-Evolution Quarterly.* Accessed online on August 12, 2004 at: http://www.preservenet.com/theory/Illich/Silence.html

______. 2005. Preface. *Limits to Medicine: The expropriation of health, Third Edition.*

Innis, H. 1954. *The Cod Fisheries: The History of an International Economy.* University of Toronto Press: Toronto.

Jansen, S. 2000. Constitution of Objects: Pest, Population, Race, Mass. IN. *Max Plank Institute for the History of Science Research Report 1998-1999.* Berlin, Germany. Accessed online on October 12, 2003 at: http://www.mpiwg-berlin.mpg.de/PDF/REPORT_SLIM.PDF.

Jessop, B. 2002. *The Future of the Capitalist State.* Polity: Oxford.

Johnson, D. 2002. Fishy Comparisons or Valid Comparisons? Reflections on a Comparative Approach to the Current Global Fisheries Malaise, With Reference to Indian and Canadian Cases. *Maritime Studies (MAST).* 1(1):103-121.

Kay, J. 1991. A Nonequilibrium Thermodynamic Framework for Discussing Ecosystem Integrity. *Environmental Management.* 15(4):483-95.

Kay, J. and Schneider E.D. 1992. Thermodynamics and Measures of Ecosystem Integrity. IN. *Ecological Indicators: Proceedings on the International Symposium on Ecological Indicators.* EDS. D.H. McKenzie, D.E. Hyatt and V.J. McDonald. Elsevier: Amsterdam.

Kay, J. and Schneider, E.D. 1994. Embracing Complexity: The challenge of the ecosystem approach. *Alternatives.* 20(3):32-38.

Kay, J.; Regier, H.; Boyle, M. and Francis, G. 1999. An Ecosystem Approach for Sustainability: Addressing the challenge of complexity. *Futures*. 31: 721-742.

Kay, J.J. and Regier, H.A. 1999. An Ecosystemic Two-Phase Attractor Approach to Lake Erie's Ecology. IN. *State of Lake Erie (SOLE)—Past, Present and Future*. EDS. M. Munawar, T. Edsall and I.F. Munawar. Backhuys: Leiden, NL.

Kay, J.J., Foster, J., 1999. About Teaching Systems Thinking. IN. *Proceedings of the HKK Conference*. EDS. G. Savage and P. Roe. 14-16 June. University of Waterloo: Waterloo.

Kay, J. 2000. *On Myths and Sustainability*. Accessed online on July 2002 at: http://www.jameskay.ca/musings/myths.html

Keats, D.; Steele, D.H. and Green, J.M. 1986. *A Review of the Recent Status on the Northern Cod Stock (NAFO Divisions 2J, 3K and 3L) and the Declining Inshore Fishery: A report to the Newfoundland Inshore Fisheries Association on scientific problems in the northern cod controversy*. Department of Biology, Memorial University of Newfoundland: St. John's, NL.

Kirby, M. 1983. *Navigating Troubled Waters: A New Policy for the Atlantic Fisheries*. Canadian Government Publishing Centre: Ottawa.

Klyashtorin, L. B. 2001. *Climate Change and Long Term Fluctuations of Commercial Catches: The Possibility of Forecasting*. FAO Fisheries Technical Paper #410. Accessed on February 12, 2004 at: http://www.fao.org/documents/show_cdr.asp?url_file=/ DOCREP/005/Y2787E/Y2787E00.HTM

Knight, R. 1996. Aldo Leopold, the Land Ethic, and Ecosystem Management. *Journal of Wildlife Management*. 60(3): 471-474.

Knight, K. (Ed). 1998. *The Macintyre Reader*. University of Notre Dame Press: Notre Dame, Indiana.

Knights, D. and McCabe, D. 2003. *Organization and Innovation: Gurus Schemes and American Dreams*. Open University Press/McGraw Hill: Milton Keynes.

Koestler, A. 1978. *Janus: A summing up*. Hutchinson: London.

Kohane, J. 2004. East/West Coast Seafood: Innovation in packaging and product offerings buoy up the industry. *Food in Canada*. November/December:38-41.

Korten, D. 1995. *When Corporations Rule the World*. Kumarian Press: San Francisco.

Kuhn, T. S. 1962. *The Structure of Scientific Revolution*. University of Chicago Press: Chicago.

Kurlansky, M. 1997. *Cod: A biography of a fish that changed the world.* Penguin Books: New York.

Kwa, C.L. 1994. Models and Modernism: Between Anxiety and Hubris. IN. *Ecology, Technology and Culture*. EDS. W. Zweers and J. Boersema. The White Horse Press: Cambridge, UK.

________. 2002. Romantic and Baroque Conceptions of Complex Wholes in the Sciences. IN. *Complexities: Social Studies of Knowledge Practices*. EDS. Law, J. and Mol, A. Duke University Press: Durham.

Larkin, P. 1988. The Future of Fisheries Management: Managing the Fisherman. *Fisheries*. 13(1):3-9.

Latour, B. 1987. *Science in Action*. Harvard University Press: Cambridge, Massachusetts.

________. 2004. *Politics of Nature: How to Bring the Sciences into Democracy*. Harvard University Press: Boston.

Latour, R.; Brush, M. and Bonzek, C. 2003. Toward Ecosystem-Based Fisheries Management: Strategies for multi-species modeling and associated data requirements. *Fisheries*. 28(9):10-22.

Law, J. 2001. *Order and Obduracy*. Centre for Science Studies. Lancaster University. Lancaster, UK. Accessed online on January 4, 2004 at: http://www.lancs.ac.uk/fss/ sociology/papers/ law-ordering-and-obduracy.pdf.

Lear, W. H. and Parsons, L.S. 1993. History and Management of the Fishery for Northern Cod in NAFO Divisions 2J,3K and 3L. IN. *Perspectives on Canadian Marine Fisheries Management*. Canadian Bulletin of Fisheries and Aquatic Sciences. DFO: Ottawa.

Lee, R.G. 1984. Sustained Yield and Social Order. IN. *History of Sustained-Yield Forestry: A Symposium.* ED. H.K. Steen. Forest History Society: Santa Cruz, CA.

Leggatt, S. 2001. *Clear Choices, Clean Waters*. Accessed on May 24, 2003 at: http://www. leggattinquiry.com/files/Leggatt_reportfinal.pdf.

Leopold, A. 1949. *A Sand County Almanac*. Oxford University Press: London.

Levin, S. 1999. *Fragile Dominion*. Yale University Press: New Haven.

Lewin, R. 1993. *Complexity: Life at the edge of chaos*. Collier Books: New York.

Lilly, G.; Brattey, J.; Fletcher, G. and Colbourne, E. 2004. The Mass Mortality of Atlantic Cod (*Gadus morhua)* in Smith Sound, Eastern Newfoundland, in April 2003. Presentation to the Canadian Conference on Fisheries Research (CCFFR) and the Society of Canadian Limnologists (SCL). January 9. St. John's, NL.

Link, J. 2002. What Does Ecosystem-Based Fisheries Management Mean? *Fisheries*. 27(4):18-21.

Livingston, J. 1982. *The Fallacy of Wildlife Conservation*. McClelland and Stewart: Toronto.

Lockett, J. 2001. Aquaculture what's on the menu? *Atlantic Business Magazine*. 12(3):52-62.

Lockwood, G. 1999. Who is Capturing Aquaculture's Values? *Aquaculture Magazine*. (January/February):30-33.

Ludwig, D. 1993. Environmental Sustainability: Magic, Science, and Religion in Natural Resource Management. *Ecological Applications*. 3(4): 555-558.

________. 2001. The Era of Management is Over. *Ecosystems*. 4:758-764

Ludwig, D.; Hilborn, R. and Walters, C. 1993. Uncertainty, Resource Exploitation, and Conservation: Lessons from history. *Science*. 260:17–18.

Luke, T. 1999a. Ecomanagerialism: Environmental Studies as a Power-Knowledge Formation. IN. *Living With Nature*. EDS. F. Fischer and M. Hajer. Oxford University Press: New York.

______. 1999b. *Capitalism, Democracy and Ecology: Departing from Marx*. University of Illinois Press: Chicago.

MacGarvin, M. 2002. Fisheries: Taking Stock. IN. *Late Lessons From Early Warnings: The precautionary principle 1896-2000: Environmental Issues Report No. 22*. ED. European Environmental Agency. Accessed online on March 22, 2004 at: http://reports.eea.eu.int/ environmental_issue_report_2001_22/en/issue-22-part-02.pdf.

MacNeil, J. W. 1971. *Environmental Management*. Information Canada: Ottawa.

MacIntyre, A. 1981. *After Virtue*. University of Notre Dame Press: Notre Dame, Indiana.

Mansfield, B. 1999. Fisheries Development or Open Access? Creating large scale fishing on the U.S. West Coast. Paper presented at *Marine Environmental Politics in the 21$^{st}$ Century*. MacArthur Program on Multilateral Governance. Institute of International Studies. University of California—Berkeley, Berkeley, California. April 30-May 2.

Accessed online on March 1, 2004 at: http://globetrotter.berkeley.edu/macarthur/marine/papers/mansfield-0.html.

___________. 2001. Property Regime or Development Policy? Explaining growth in the US Pacific groundfish fishery. *Professional Geographer*. 53(3):384-397.

___________. 2004. Neoliberalism in the Oceans: "Rationalization," property rights, and the commons question. *Geoforum*. 35:313-326.

Maravelias, C. 2003. Post-Bureaucracy—Control through professional freedom. *Journal of Organizational Change Management*. 16(5):547-566.

Marshall, D. 2003. *Fishy Business: The Economics of Salmon Farming in B.C.* Canadian Centre for Policy Alternatives, BC Office: Vancouver, B.C. Accessed online on February 2, 2004 at: http://www.livingoceans.org/documents/ fishy%20business.pdf.

Martin, C. 1992. *No Fish and Our Lives*. Creative Publishers: St. John's, NL.

Matthews, D.R. 1986. The Outport Breakup. *Horizon Canada*.Vol.9:pp 2438-2443. Accessed online on March 23, 2004 at: http://collections.ic.gc.ca/placentia/outprt.htm.

____________. 1993. *Controlling Common Property: Regulating Canada's East Coast Fishery*. University of Toronto Press: Toronto.

McCarthy, M. and Prudham, S. 2004. Neoliberal Nature and the Nature of Neoliberalism. *Geoforum*. 35:275-283.

McCay, B. 1994. The Oceans Commons and Community. *Dalhousie Review*. 3(2):310-338.

_________. 2000. Post-Modernism and the Management of Natural and Common Resources. *Quarterly Publication of the International Association for the Study of Common Property*. 54:1-8.

_________. 2002a. Co-management and Crisis in Fisheries Science and Management. IN. Marine Resources: Property Rights, Economics and Environment Vol. 14. EDS. M. Falque, M. De Alessi and H. Lamotte. JAI Press: New York.

McCay, B. and Finlayson, C. 1995. *The Political Ecology of Crisis and Institutional Change: The Case of the Northern Cod.* Presented to the Annual Meetings of the American Anthropological Association, Washington, D.C., November 15-19, 1995. Accessed on January 10, 2004 at: http://arcticcircle.uconn.edu/NatResources/cod/mckay.html

McGrath, D. 2004. Taming the Fishery: Scientists and entrepreneurs believe aquaculture is the way of the future. *The Downhomer*. 16(9): 74-78.

Meffe, G. 1992. Techo-Arrogance and Halfway Technologies: Salmon Hatcheries on the Pacific Coast of North America. *Conservation Biology*. 6(3):350-354.

Memorial University of Newfoundland (MUN). 2005. *Management of the Northern Cod Fishery: Northwest Atlantic Fisheries Management Divisions (Map).* Centre for Newfoundland Studies. Accessed online on March 2, 2005 at: http://www.library.mun.ca/qeii/cns/cod/geog1.jpg.

Merchant, C. 1980. *The Death of Nature: Women ecology and the scientific revolution.* Harper & Row: New York.

__________. 1992. *Radical ecology: The search for a liveable world.* Routledge: New York.

__________. 1996. *Earthcare: Women and the Environment.* Routledge: New York.

__________. 1998. Fish First! The Changing Ethics of Ecosystem Management. *Human Ecology Review.* 4(1): 25-30.

__________. 2003. *Reinventing Eden: The fate of nature in Western culture.* Routledge: New York.

_________. 2005. *Major Problems in American Environmental History, 2nd Edition.* Houghton Mifflin Company. New York.

Mitchell, B. 1979. *Geography and Resource Analysis.* Longman: New York.

_________. 1997. *Resource and Environmental Management.* Longman: London.

__________. 1999. *Resource Management Lecture.* Geography Graduate Seminar GEOG 691. November 17. University of Waterloo, Waterloo, Ontario.

Morgan, G. 1986. *Images of Organization.* Sage: Beverly Hills.

Murray, G., Bavington, D. and Neis, B. (2005, forthcoming). Local Ecological Knowledge, Science, Participation and Fisheries Governance in Newfoundland and Labrador: A Complex, Contested and Changing Relationship. IN. *Participation in Fisheries Governance.* ED. Tim Gray. Kluwer Academic Press: London, UK.

Nadasdy, P. 2003a. The politics of TEK: Power and the "Integration" of Knowledge. IN. *Natural Resources and Aboriginal People in Canada: Readings, cases, and commentary.* EDS. R. Anderson and R. Bone. Captus Press: Concord, Ontario.

__________. 2003b. Hunters and Bureaucrats: Power, Knowledge, and Aboriginal-State Relations in the Southwest Yukon. UBC Press: Vancouver.

National Film Board of Canada (NFB). 1989. *Fish Wars (Transcript)*. NFB: Ottawa.

Natural Resources Canada (NRC). 2003. *Climate Change Impacts and Adaptation: A Canadian Perspective (Fisheries)*. Government of Canada. Ottawa. Accessed on March 20, 2004 online at: www.adaptation.nrcan.gc.ca/perspective_e.asp.

Naylor, R.; Goldberg, R.; Primaversa, J.; Kautsky, N.; Beveridge, M.; Clay, J.; Folke, K.; Lubchenco, J.; Mooney, H. and Troell, M. 2000. Effects of Aquaculture on World Fish Supplies. *Nature*. 405/6790:1017-24.

Neimark, P. and Mott, P. 1999. *The Environmental Debate: A Documentary History*. Greenwood Press: New York.

Neis, B. 1991. Flexible Specialization: What's that got to do with the price of fish? *Studies in Political Economy*. 36:145-170.

______. 1992. Fishers' Ecological Knowledge and Stock Assessment in Newfoundland and Labrador. *Newfoundland Studies*. 8:155-178.

Neis, B.; Felt, L.; Haedrich, D. and Schneider, D.C. 1999a. An Interdisciplinary Method for Collecting and Integrating Fishers Ecological Knowledge into Resource Management. IN. *Fishing Places, Fishing People*. EDS. D. Newell and R. Ommer. University of Toronto Press: Toronto.

Neis, B.; Schneider, D.C.; Felt, L.; Haedrich, D.; Fischer, J. and Hutchings, J.A. 1999b. Fisheries Assessment: What can be learned from interviewing resource users? *Canadian Journal of Fisheries and Aquatic Sciences*. 56:1949-63.

Neis, B. and Felt, L (Eds.). 2000. *Finding Our Sea Legs: Linking Fishery People and Their Knowledge with Science and Management*. ISER Books: St. John's, NL.

Neis, B.; Grzetic, B. and Pidgeon, M. 2001. *From Fishplant to Nickel Smelter: Health Determinants and the Health of Women Fish and Shellfish Processors in an Environment of Restructuring*. Memorial University of Newfoundland, St. John's, NL.

Newell, D. and Ommer, R. 1999. Introduction: Traditions and Issues. IN. *Fishing Places, Fishing People*. EDS. D. Newell and R. Ommer. University of Toronto Press: Toronto.

Newfoundland and Labrador All-Party Committee on the 2J3KL and 3Pn4RS Cod Fisheries. 2003. *Stability, Sustainability and Prosperity: Charting a Future for Northern and Gulf Cod Stocks*. Government of Newfoundland and Labrador: St. John's, NL

Newfoundland Aquaculture Industry Association (NAIA). 2002. An Analysis of the Growout Phase of the Egg-to-Plate Cod Aquaculture Industry in Newfoundland and Labrador. NAIA, St. John's: NL.

_______________________________________________. 2003. *Cultivating a Sustainable Future—Cold Harvest™ 2003*. NAIA Annual Conference. March 18-20. Gander, NL.

_______________________________________________. 2004. *Putting the Aquaculture Industry in Context: Companies Need a Hand Up Not a Hand Out.* Press Release. NAIA, St. John's: NL.

Newfoundland Television Network (NTV). 2004. *NTV Late Night News*. March 10.

Newkirk, G. 1996. Sustainable Coastal Production Systems: A Model for Integrating Aquaculture and Fisheries Under Community Management. *Ocean & Coastal Management*. 32(2):69-83.

Oelschlaeger, M. 1991. *The Idea of Wilderness*. Yale University Press: London.

______________. 1994. *Caring for Creation*. Yale University Press: New York.

O'Malley, P. 2003. Governable Catastrophes: A Comment on Bougen. *Economy and Society*. 32(2):275-279.

Ommer, R. 1994. One Hundred Years of Fisheries Crisis in Newfoundland. *Acadiensis*. 2(Spring):5-20.

Ommer, R. (Ed). 2002. *The Resilient Outport: Ecology, economy, and society in rural Newfoundland.* ISER Books: St. John's, NL.

Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, Cambridge.

________. 1999. Coping with tragedies of the commons. *Annual Review of Political Science*. 2:493-535.

Ottesen, G. and Gronhaug, K. 2003. Primary Uncertainty in the Seafood Industry: An exploratory study of how processing firms cope. *Marine Resource Economics*. 18:363-371.

Ottino, J.M. 2004. Engineering Complex Systems. *Nature*. 427 (29 January):399.

Oxford English Dictionary. 1989. Oxford University Press: London.

Paehlke, R. and Torgerson, D. (Eds). 1990. *Managing Leviathan*. Broadview Press: Peterborough.

Palmer, C. 1992. Stewardship: A case study in environmental ethics. IN. *The Earth Beneath*. EDS. I. Ball, M. Goodall, C. Palmer and J. Reader. SPCK: London.

Palsson, G. 2000. Finding One's Sea Legs: Learning, the process of enskillment, and integrating fishers and their knowledge into fisheries science and management. IN. *Finding Our Sea Legs: Linking Fishery People and Their Knowledge with Science and Management*. EDS. B. Neis and L. Felt. ISER Press: St. John's, NL.

Parker, M. 2002. *Against Management*. Blackwell Publishers: Malden, MD.

Patton, P. 2003. Language, Power, and the Training of Horses. IN. *Zoontologies: The Question of the Animal*. ES. Cary Wolfe. University of Minnesota Press: Minneapolis.

Pauly, D. 1995. *When is Fisheries Management Needed?* Presentation at the Joint FF A/SPC Workshop on the Management of South Pacific Inshore Fisheries. June 26 – July 7,1995, Noumea, New Caledonia. Accessed online on March 5, 2004 at: http://www.spc. int/coastfish/Reports/ICFMAP/pauly.pdf

Pauly, D. and Christensen, V. 1995. Primary production required to sustain global fisheries. *Nature*. 374**,** 255–257.

Pauly, D.; Christensen, V.; Salsgard, J.; Froese, R. and Torres, Jr. F. 1998. Fishing Down Marine Food Webs. *Science*. 279:860-863.

Pauly, D.; Tyedmers, P.; Froese, R. and Liu, L. Y. 2001. Fishing down and farming up the food web. *Conservation Biology in Practice*. 2(4):25.

Pauly, D.; Christensen, V.; Guénette, S.; Pitcher, T.; Sumaila, R.; Walters, C.; Watson, R. and Zeller, D. 2002. Towards sustainability in world fisheries. *Nature*. 418(August):689-695.

Pauly, D. and Maclean, J. 2003. *In a Perfect Ocean: The state of fisheries and ecosystems in the North Atlantic Ocean*. Island Press: London.

Peet, R and Watts, M. (Eds). 1996. *Liberation Ecologies: Environment, Development, Social Movements*. Routledge: New York.

________________________. 2004. *Liberation Ecologies: Environment, Development, Social Movements 2nd Edition*. Routledge: New York.

Peluso, N. 1993. Coercing Conservation? *Global Environmental Change*. June:199-217.

Peters, B. G. 1998. Governing without Government: Rethinking Public Administration. *Journal of Public Administration Research and Theory* 8(2): 223-243.

Peters, T. and Waterman, R. 1988. *In Search of Excellence.* Little Brown Trade Division: New York.

Peterson, D. and Parker, V. (Eds). 1998. *Ecological Scale: Theory and Applications.* Columbia University Press: New York.

Plumwood, V. 2002. *Environmental Culture: The ecological crisis of reason.* Routledge: New York.

Pickersgill, P. (Political Cartoonist). 2003. Properly Managed this Species Can Make a Full Recovery. *The Express.* March 12-18$^{th}$. Pg. 10.

Pinchot, G. 1910. *The Fight for Conservation.* Harcourt Brace: Garden City.

Pinkerton, E. 1990. *Co-operative Management of Local Fisheries.* University of British Columbia Press: Vancouver.

__________. 1994. Cooperative management as a strategy for the sustainable management of fisheries. *Canadian Journal of Fisheries and Aquatic Sciences.* 51:2363-78.

___________. 1999. Factors in Overcoming Barriers to Implementing Co-management in British Columbia Salmon Fisheries. *Conservation Ecology.* 3(2):2.

Pitcher, T.; Hart, P. and Pauly, D. (Eds). 1998. *Reinventing Fisheries Management.* Kluwer Academic Publishers: Boston.

Poerksen, U. 1995. *Plastic Words.* Pennsylvania State University Press: University Park, PA.

Policansky, D. 1993. Fishing as a cause of evolution in fishes. IN. *The Exploitation of Evolving Resources.* EDS. T. K. Stokes, J. M. McGlade and R. Law. Springer: New York.

Polanyi, K. 1957. *The Great Transformation: The political and economic origins of our time.* Beacon Press: New York.

Pollitt, C. 1990. *Managerialism and the Public Services: An Anglo-American Experience.* Blackwell: Oxford.

Popper, A. 2003. Effects of Anthropogenic Sounds on Fishes. *Fisheries.* 28(10):24-31.

Power, M. 2004a. Counting, Control and Calculation: Reflections on measuring and management. *Human Relations.* 57(6):756-783.

Power, N. 2004b. *An Examination of the Impacts of and Responses to the Restructured Newfoundland Fishery.* ISER Books: St. John's, NL.

Power, N. 2005. *What do they Call a Fisherman? Men, Gender, and Restructuring in the Newfoundland Fishery.* ISER Books: St. John's, NL.

Professional Fish Harvesters Certification Board Newfoundland and Labrador (PFHCBNL). 2000a. *Board Policy: Maintenance of Status.* PFHCB: St. John's, NL.

___________. 2000b. *Code of Ethics for Professional Fish Harvesters.* June. PFHCB: St. John's, NL.

___________. 2000c. *Fish Harvester Professionalization—General Information.* November. PFHCB: St. John's, NL.

___________. 2004. *Frequently Asked Questions.* Accessed on October 12, 2004 at: http://www.pfhcb.com/.

Public Citizen. 2004. *North American Free Trade Agreement (NAFTA).* Accessed online on February 4, 2004 at: http://www.citizen.org/trade/nafta/.

Rahnema, M. 1993. Participation. IN. *The Development Dictionary.* ED. W. Sachs. Zed Books: London.

Ramos-Martin, J. 2003. Empiricism in Ecological Economics: A perspective from complex systems theory. *Ecological Economics.* 46:387-398.

Rasch, W. and Wolfe, C. (Eds). 1999. *Observing Complexity.* University of Minnesota Press: Minneapolis.

Ravetz, J.R. 1999. What is post-normal science? *Futures.* 31(9):647-653.

Ravetz, J. and Funtowicz, S. 1999. Post-Normal Science—an insight now maturing. *Futures.* 31(9):641-646.

Regan, G. 2004. *Speaking Notes for The Honourable Geoff Regan, P.C., M.P. Minister of Fisheries and Oceans Canada to the United Nations General Assembly.* New York, N.Y. November 16, 2004. Accessed online on March 14, 2005 at: http://www.dfo-mpo.gc.ca/media/speech/2004/20041116_e.htm

Regier, HA. and Kay, JJ. 1996. An Heuristic Model of Transformations of the Aquatic Ecosystems of the Great Lakes-St. Lawrence River Basin. *Journal of Aquatic Ecosystem Health.* 5:3-21.

Rice, J.; Shelton, P.; Rivard, D.; Chouinard, G. and Fréchet, A. 2003. Recovering Canadian Atlantic Cod Stocks: The shape of things to come? Presented at the

*International Council for Exploration of the Sea Annual Conference* in Tallin, Estonia (September). CM 2003/U:06. Accessed on January 4, 2004 at: http://www.ices.dk/ products/CMdocs/2003/ U/U0603.PDF.

Roach, C. 2000. Stewards of the Sea: A Model for Justice?. IN. *Just Fish*. EDS. H. Coward, R. Ommer and T. Pitcher. ISER Press: St. John's, NL.

Rogers, R. 1995. *The Oceans are Emptying: Fish wars and sustainability*. Black Rose: Montreal.

________. 1999. The Voyage Out and the Voyage Back: Ecological knowledge and Canada's East Coast Fishery. Issues Position Paper. Ecological Knowledge Working Seminar. St. Francis Xavier May 24-31, 1999. Accessed online on February 20, 2004 at: http://www.stfx. ca/ research/ecoknow/6504a23.htm.

Rose, G.A. 2003. *Fisheries Resources and Science in Newfoundland and Labrador: An Independent Assessment*. Research Paper for the Royal Commission on Renewing and Strengthening Our Place in Canada. Government of Newfoundland and Labrador: St. John's, NL.

Rose, N. 1999. *Powers of Freedom: Reframing political thought*. Cambridge University Press. Cambridge.

Rosen, R. 2000. *Essays on Life Itself*. Columbia University Press: New York.

Rosenberg, A. 2003. Managing to the Margins: The overexploitation of fisheries. *Frontiers in Ecology and Environment*. 1(2):102-106.

Rosenhead, J. 1998. Complexity Theory and Management Practice. *Science as Culture*. Accessed online on February 5, 2004 at: http://human-nature.com/science-as-culture/rosenhead.html.

Ross, E. 1998. *The Malthus Factor: Poverty, politics and population in capitalist development*. Zed Books: New York.

Rowe, D (Fisheries Products International President). 2004a. Interviewed on CBC Radio's Fisheries Broadcast, January 14.

________________________________________. 2004b. *Global Trends in Food Quality, Safety and Marketing. Presentation to Newfoundland Aquaculture Industry Annual Conference and Trade Show*. February 10th.Holiday Inn, St. John's, NL.

Rowe, S. and Hutchings, J. 2004. Implications of Mating Systems for the Collapse and Recovery of Atlantic Cod. Presentation to the *Canadian Conference on Fisheries Research (CCFFR) and the Society of Canadian Limnologists (SCL)*. January 9. St. John's, NL.

Royal Society of Canada. 2001. *Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada.* An Expert Panel Report on the Future of Food Biotechnology. The Royal Society of Canada: Ottawa.

Ruzzante, D.; Wroblewski, J.; Taggart, C.; Smedbol, R.; Cook, D. and Goddard, S. 2000. Bay-Scale Population Structure in Coastal Atlantic Cod in Labrador and Newfoundland. *Canadian Journal of Fisheries Biology.* 56:431-47.

Sachs, W. 1992. Environment. IN. *The Development Dictionary.* ED. Wolfgang Sachs. Zed Books: Halifax, Nova Scotia.

_________. 1993. Global Ecology and the Shadow of 'Development.' IN. *Global Ecology.* ED. W. Sachs. Fernwood Books Ltd: Halifax, Nova Scotia.

____________. 1999. *Planet Dialectics: Explorations in Environment and Development.* Fernwood Publishing: Halifax, Nova Scotia.

Sachs, W.; Loske, R. and Linz, M. 1998. *Greening the North : a post-industrial blueprint for ecology and equity.* Zed Books: London.

Sackton, J. (CEO of Seafood.com). 2003. Cultivating a Sustainable Future: Global Markets and Outlook. Presentation at *Cultivating a Sustainable Future—Cold Harvest™ 2003.* Newfoundland Aquaculture Industry Association Annual Conference. March 19. Gander, NL.

Samuel, S. 2004. *Consoling Thoughts about Tyranny at the end of the Age of Experts.* Presented at the Workshop "Guiding Societies: Experts and public choices in the 19th and 20th century." European University Institute, June 1st, 2002. Accessed on September 23, 2004 at: http://www. pudel.uni-bremen.de/pdf/Samuel_EUI_lecture _060102v3_en.pdf.

Sandilands, C. 1999. *The Good Natured Feminist.* University of Minnesota Press: London.

Sardar, Z. and Ravetz, J. 1994. Complexity: Fad or future?. *Futures.* 26(6):563-567

Saul, J.R. 1992. *Voltaire's Bastards: The dictatorship of reason in the west.* Penguin Books: Toronto.

_______. 1995. *The Unconscious Civilization.* Anansi Press: Toronto.

Saurette, P. 2004. Questioning Political Theory: Charles Taylor's Contrarianism. *Political Theory.* 32(5):723-733.

Savoie, D. 1995. What is wrong with the New Public Management? *Canadian Public Administration* 38(1): 112-121.

Savoie, D. 1999. *Governing from the Centre: The Concentration of Power in Canadian Politics.* Toronto: University of Toronto Press.

Sayer, A. 2000. *Realism and Social Science.* Sage: London.

Scheffer, M.; Carpenter, S.; Foley, J. A.; Folke, C. and Walker, B. 2001. Catastrophic shifts in ecosystems. *Nature.* 413, 591–596.

Schlosberg, D. 1999. *Environmental Justice and the New Pluralism: The challenge of diversity for environmentalism.* Oxford Univeristy Press: New York.

Schrank, W.; Arnason, R. and Hannesson, R. (Eds). 2003. *The Cost of Fisheries Management.* Ashgate: Burlington, VT.

Scott, J. 1998. *Seeing Like a State.* Yale University Press: London.

Senge, P. 1990. *The Fifth Discipline: The Art and Practice of the Learning Organization.* Century Business: London.

Sessions, G. (Ed). 1995. *Deep Ecology for the 21st Century.* Shambhala Publishers: Boston.

Sharpe, G. 2004. *Historical Fishing Events and Climate Fluctuations.* Accessed on March 2, 2004 at: http://sharpgary.org/FisheryTimeline.html.

Shenhav, Y. 1999. *Manufacturing Rationality: The engineering foundations of the managerial revolution.* Oxford University Press: Oxford.

Shiva, V. 1993. Resources. IN. *The Development Dictionary.* ED. W. Sachs. Zed Books: London.

Sinclair, P. 1988. The State Encloses the Commons: Fisheries Management from the 200-Mile Limit to Factory Freezer Trawlers. IN. *A Question of Survival: The Fisheries and Newfoundland Society.* ES. P. Sinclair. ISER Press: St. John's, NL.

Sinclair, M. and Solemdal, P. 1988. The Development of "Population Thinking" in Fisheries Biology Between 1878-1930. *Aquatic Living Resources.* 1:189-213.

Singh, J. and van Houtum, H. 2002. Post-Colonial Nature Conservation in Southern Africa: Same emperors, new clothes? *GeoJournal.* 58:253-263.

Sinisi, J. 1994. The Shadow of Hobbes. *Rethinking Marxism.* 7(2):87-99.

Slocombe, S.D. 1993. Environmental Planning, Ecosystem Science, and Ecosystem Approaches for Integrating Environment and Development. *Environmental Management.* 17(3):289-303.

____________. 1998. Lessons from experience with ecosystem-based management. *Landscape and Urban Planning.* 40:31-39.
Smith, D.M. 2000a. *Moral Geographies: Ethics in a World of Difference.* Edinburgh University Press: Edinburgh.

Smith, T. 1994. *Scaling Fisheries: The science of measuring the effects of fishing, 1855-1955.* Cambridge University Press: Cambridge.

Species at Risk Act (SARA). 2004a. *Species at Risk Act Registry on Atlantic Cod.* Accessed on October 29, 2004 at: http://www.sararegistry.gc.ca/virtual_sara/files/ cosewic/sr%5Fatlantic %5Fcod%5Fe%2Epdf.

________________________. 2004b. *Species at Risk Act Legal Listing Consultation Workbook Atlantic Cod (Gadus morhua): Newfoundland and Labrador Population of Atlantic Cod (2GHJ3KLNO).* Fisheries and Oceans Canada: Ottawa.

Stanley, M. 1983. The Mystery of the Commons: On the Indispensability of Civic Rhetoric. *Social Research.* 50(4): 851-883.

Stanley, T. R. 1995. Ecosystem Management and the Arrogance of Humanism. *Conservation Biology.* 9(2): 255-62.

Steele, D.H., Anderson, R. and Green, J.M. 1992. The Managed Commercial Annihilation of Northern Cod. *Newfoundland Studies.* 8(1):34-68.

Steele, J. H. 1998. Regime shifts in marine ecosystems. *Ecological Applications.* 8(1): S33–S36.

Smedbol, R.; Schneider, D.; Wroblewski, J. and Methven, D. 1998. Outcome of an Inshore Spawning Event by Northern Atlantic Cod (*Gadus morhua*) at Low Stock Level. *Canadian Journal of Aquatic Sciences.* 55:1-9.

Taggart, C.; Ruzzante, D. and Cook, D. 1998. Localised Stocks of Cod (*Gadus morhua* L.) in the Northwest Atlantic: The genetic evidence and otherwise. IN. *The Implications of Localized Fishery Stocks.* EDS. I. Hunt von Herbing, I. Kornfield, M. Tupper and J. Wilson. NRAES: Ithica, N.Y.

Taylor, C. 1993. *The Ethics of Authenticity.* Harvard University Press: Boston.

Taylor, F. 1911. *The Principles of Scientific Management.* Harper: New York.

Thompson, M. and Trisoglio, A. 1997. Managing the Unmanageable. IN. *Saving the Seas*. EDS. L. Brooks and S. VanDever. Sea Grant Press: College Park, MD.

Thompson, E.P. 1963. *The Making of the English Working Class*. Vintage: New York.

Thrift, N. 1999. The Place of Complexity. *Theory, Culture and Society*. 16(3):31-69.

Tognetti, S. 1999. Science in a double-bind: Gregory Bateson and the origins of post-normal science. *Futures*. 31(9): 689-703.

Torgerson, D. 1990. Obsolescent Leviathan: Problems of Order in Administrative Thought. IN. *Managing Leviathan*. EDS. R. Paehlke and D. Torgerson. Broadview Press: Peterborough.

___________. 1999. *The Promise of Green Politics*. Duke University Press: London.

Tyedmers, P. 2000. Salmon and Sustainability: The Biophysical Cost of Producing Salmon Through the Commercial Salmon Fishery and the Intensive Salmon Culture Industry. Unpublished Dissertation, UBC, Vancouver.

United Nations. 1982. *United Nations Convention on the Law of the Sea of 10 December 1982 (UNCLOS)*. Accessed on February 2, 2005 online at: http://www.un.org/Depts/los/ convention_agreements/ convention_overview_convention.htm

Van der Schans, J.W. 2001. *Governance of Marine Resources: Conceptual Clarification and Two Case Studies*. Edburon: Delft, Netherlands.

VanDeVeer, D. and Pierce, C. 1998. *The Environmental Ethics and Policy Book 2nd Edition*. Wadsworth Publishing: New York.

Vardy, D. and Dunne, E. 2003. *New Arrangements for Fisheries Management in Newfoundland and Labrador*. Report to the Royal Commission on Renewing and Strengthening Our Place in Canada. Government of Newfoundland and Labrador: St. John's.

Vas, P. and Bruno, F. 2003. Types of Self-Surveillance: from abnormality to individuals 'at risk'. *Surveillance & Society*. 1(3): 272-291.

Volpe, J. 2001. *Super Un-Natural: Atlantic Salmon in BC Waters*. David Suzuki Foundation: Vancouver, BC.

Von Hayek, F. 1944. *The Road to Serfdom*. University of Chicago Press: Chicago.

Wallace, M.; Cortner, H. and Moote, M. 1996. Moving Toward Ecosystem Management: Examining a Change in Philosophy for Resource Management. *Journal of Political Ecology*. 3:1-36.

Walters, C. J. and Maguire, J. J. 1996. Lessons for stock assessment from the Northern Cod collapse. *Reviews in Fish Biology and Fisheries.* 6:125–137.

Walters, W. 2004. Some Critical Notes on "Governance." *Studies in Political Economy.* 73(Spring/summer): 27-46.

Waltner-Toews, D; Kay, J; Neudoerffer, C. and Gitau, T. 2003. Perspective Changes Everything: Managing ecosystems from the inside out. *Frontiers in Ecology and the Environment.* 1(1):23-30.

Watling, L. and Norse, E.A. 1998. Disturbance of the seabed by mobile fishing gear: a comparison to forest clearcutting. *Conservation Biology.* 12:1180–1197.

Welbourn, K. 1996. *Outport Outlaws: The Criminalization of Rural Newfoundland.* CBC Radio *Ideas* Transcript. CBC: Toronto.

Weinberg, G.M. 1975. *An Introduction to General Systems Thinking.* Wiley: New York.

Wilen, J. 2004. Spatial Management of Fisheries. *Marine Resource Economics.* 19:7-19.

Williams, R. 1980. *Keywords: A vocabulary of culture and society (Revised Edition).* Oxford University Press: New York.

Willmott, H. 1993. Strength Is Ignorance; Slavery Is Freedom: Managing Culture in Modern Organizations. *Journal of Management Studies.* 30(4):515–52.

Wilson, G. and Bryant, R. 1997. *Environmental Management: New Directions for the Twenty-First Century.* UCL Press: London.

Wilson, J. 2002. Scientific Uncertainty, Complex Systems, and the Design of Common Pool Institutions. IN. *The Drama of the Commons.* EDS. Committee on the Human Dimensions of Global Change, E. Ostrom, T. Dietz, N. Dolsak, P.C. Stern, S. Stonich, and E. Weber, Division of Behavioral and Social Sciences and Education. National Academy Press: Washington, DC.

____________. 1988. Comments on Passive Management. In. *Fisheries Science and Management: Objectives and limitations.* Ed. W. Wooster. Springer-Verlag: New York.

Winsor, F. 2004. *Fred Winsor Executive Director of the Fisheries Recovery Action Committee (FRAC).* Interviewed on CBC Radio's Fisheries Broadcast, January 28.

Winsor, F. and Bavington, D. 2004. South Coast Cod Stocks in Danger. *The Evening Telegram.* February 29:A7.

Wiseman, M.; Burge, M. and Burge, H. 2001. *Fishing Vessel Safety Review (less than 65 feet).* Department of Fisheries and Oceans, Coast Guard DFO Intra-Departmental Working Group.

Worster, D. 1993. The Shaky Ground of Sustainability. IN. *Global Ecology*. ED. W. Sachs. Zed Books: London.

————. 1994. *Nature's Economy: A history of ecological ideas.* Cambridge University Press: Cambridge.

————. 1995. Nature and the Disorder of History. IN. *Reinventing Nature? Responses to postmodern deconstruction*. EDS. M. Soulé and G. Lease. Island Press: Washington, D.C.

Wright, M. 2001. *A Fishery For Modern Times*. Oxford University Press: Toronto.

Wroblewski, J. 1998. Substocks of Northern cod and Localized Fisheries in Trinity Bay, Eastern Newfoundland and in Gilbert Bay, Southern Labrador. IN. *Proceedings of the Workshop on Cod Stock Components*. ED. J.R. Rice. Canadian Stock Assessment Process Series. DFO: Ottawa.

____________. 1999. The Colour of Cod: Fishers and Scientists Identify a Local Cod Stock in Gilbert Bay, Southern Labrador. IN. *Finding Our Sea Legs*. EDS. B. Neis and L. Felt. ISER Books: St. John's, NL.

____________. 2003. *Investigation of Local Fisheries Resources of the Labrador Coast.* Coasts Under Stress Research Project. Accessed on March 23, 2004 at: http://www.coastsunderstress. ca/arm3/wroblewski.html.

Wroblewski, J.S., W.L. Bailey and J. Russell. 1998. Grow-out cod farming in southern Labrador. *Bulletin of the Aquaculture Association of Canada*. 98(2):47-49.

Wroblewski, J., Volpe, J. and Bavington, D. (Forthcoming, 2005). Manufacturing fish: Transition from wild harvest to aquaculture. IN. *Power, Agency and Nature: Shaping Coastal Society and Environment*. EDS. P. Sinclair and R. Ommer. ISER Press: St. John's, NL.